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GUY'S HOSPITAL REPORTS.

EDITED BY

FREDERICK TAYLOR, M.D.

AND

N. DAVIES-COLLEY, M.A., M.C.

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York Medical Society (care of Fred. Shann, Esq., 69, Petergate,
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In Exchange.

The St. Bartholomew's Hospital Reports.

The St. George's Hospital Reports.

The St. Thomas's Hospital Reports.

The Westminster Hospital Reports.

The Liverpool Medico-Chirurgical Journal (care of Dr. James Barr, 1, St. Domingo Grove, Liverpool).

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In Memoriam.

FREDERICK HORATIO AKBAR MAHOMED.

The late Dr. Mahomed was born at Brighton in April, 1849. His parents were English, but his paternal grandfather was a native of Patna, in Hindostan, and lived, it may be remarked in passing, to the advanced age of 101 years. His paternal grandmother was an Englishwoman, a native of Bath. In his life-history album Mahomed thus describes himself in his own handwriting: "As a child, rampagious, irritable, and passionate; always restless and excitable, and giving them no peace in his home; in early boyhood not remarkable for any brilliancy, maintaining a good average place at school, with a tendency towards mathematics, weak in languages, fond of mechanical toys, and apt in constructing them." Our readers need no reminder that in this was foreshadowed his subsequent bent towards the construction of physiological apparatus. From school he went to the Sussex County Hospital, and in the year that he remained there he attracted the attention of the late Dr. Ormerod, as a thoroughly excellent and diligent student. From thence he entered at Guy's in 1869, rapidly becoming marked out amongst his fellows as one likely to lead later on. He not only carried off prizes in 1870 and 1871, but in other ways, and much more unusual ones, he showed himself to be a man of exceptional ability. While others were still studying anatomy and physiology he gave practical proof of having mastered these subjects. One of the writers, who lived with him

as a second year's student in 1870 and 1871, remembers well the frequent visits to a clever working jeweller at Forest Hill, to whom had been entrusted the carrying out of Mahomed's modifications of Marey's sphygmograph. The time occupied in the daily railway journey from Forest Hill to London Bridge Mahomed always spent either wrapped in the study of Marey's work on the instrument which was now engaging his leisure, to the great interest of the City clerks, who filled the early morning train; or else, absorbed by his Ellis, and needing an occasional friendly kick when his neighbours grew too interested in the study of one of the figures, happily few and far between.

In 1872 Mahomed qualified, an earnest desire to be off his friends' hands, and his being engaged to be married, causing him to turn aside alike from all thoughts of the London University, and from hopes of the highest students' appointments at Guy's. But it is right to say that just as a year before he had shown himself ahead of his coevals in his earlier studies, so now he had outstripped them in more purely professional subjects.

A marked leaning to medicine early characterised Mahomed. When others of his year were holding junior appointments, he was ranging the medical wards, acquainting himself with the powers of the sphygmograph, and at the same time gaining an insight into disease which to one of his fertile brain was certain to prove capable of good use later on. At these times Mahomed was often gently ridiculed; he had a hobby, and everything ran on sphygmographic lines, but the hobbies of youth are corrected by the maturity of age, and the maxim that everyone should have a hobby was certainly strengthened by Mahomed's case, for he absorbed a knowledge which far outstripped the scope of his immediate work.

The results of this work were remarkable, for in the same year that he qualified—then only his third year at Guy's—he published an elaborate series of papers on the sphygmograph, which at once made his name well known, and to which we shall again refer. In this year, chiefly as a result of the influence of one of his after-colleagues[1] with Sir Sydney Waterlow, Mahomed was elected Assistant Medical Officer to the Highgate Infirmary,

[1] Mr. Durham.

and about a year later, April, 1873, he was elected to the valuable post of resident medical officer to the London Fever Hospital, and soon afterwards he married. This appointment he held till February, 1875, and he resigned it when elected to the post of medical tutor and pathologist to St. Mary's Hospital. He now took a house in Norfolk Square with pupils, but his home was early broken up by the death of his first wife, and in 1877 his earnest and constant wish to return to his old school was gratified by his election at Guy's as Medical Registrar.

He now gave a very marked proof of his untiring energy. In 1875 he had taken the degree of M.D. at Brussels; but, dissatisfied with this, within a few hours of his election at Guy's he turned his attention, by the advice of a friend, to Cambridge. Situated as he was as Medical Registrar he could only take a Cambridge degree by availing himself of the minimum of residence required. He regularly left London every other day, after a hard day's work at the hospital, for Cambridge, returning to town on the following morning; and in this laborious way he managed to complete his terms, and proceed to the M.B. degree. One could wish that more opportunities of this kind were open for men situated like Mahomed—able men under circumstances of peculiar difficulty —to obtain such a degree as that of Cambridge in medicine.

It was during this time that he made the acquaintance of Professor Humphry, and it is no small thing to say that from the friendship which then originated has sprung the good work done by the Collective Investigation Committee.

His residence at Cambridge over, he was able to throw himself heart and soul into his London work. In 1881 he was elected Assistant Physician to Guy's Hospital, and in the same year also one of the Demonstrators of morbid anatomy, and about this time he married again.

It might be thought by some that now his future lay bright before him. He had only to work steadily as a hospital physician and teacher to acquire in due course a substantial position in consulting practice. In many respects it must be said it might have been better for him had he thus confined his energies. But a man must be taken as we find him, Mahomed could not have been other than one battling with work which

he had created, work which was always too much for him, but to which he nevertheless relentlessly added, without any regard for himself. To his appointments at Guy's were added that of Physician to the London Fever Hospital, Physician to the Edinburgh Assurance Company, and Sanitary Inspector to the Welford Milk Farms.

To say that Mahomed was a man of progress may perhaps express in short the many outlets for the activity of his mind. If any fresh subject were mooted, provided that he did not start it, he always had something to say. He seemed to delight in committees and was a member of we know not how many. He was an active man at his medical school, active at the College of Physicians, the meetings of which he regularly attended, and at which he was commencing to speak with some frequency. He was active amongst the profession at large in questions scientific, sanitary, medico-political, social; no matter what it was, a pressing discussion of any sort found Mahomed somewhere in the outskirts, waiting, eager, almost panting to join in. And thus his last illness found him.

The origin of his attack of typhoid fever could not be detected. It commenced by a definite rigor, and, for the first few days, ran a comparatively mild course. He supposed it to be a bilious attack, such as he was subject to, and in this belief, though with a temperature of 104°, he came down to Guy's to see a student who was alarmingly ill with rheumatic hyperpyrexia. His wife remonstrating with him for leaving his room, was met with this rejoinder, showing his characteristic courage and energy, "Would you have me stay at home for a bilious attack when the life of another is in danger?"

For some days after this the course of the disease still continued favorable, but he was much troubled with headache, and curiously from the very first he had a presentiment of the occurrence of hæmorrhage. His friends smiled at this, and asked him to think how well he was progressing; nevertheless his forecast was correct, and this symptom of ill omen appeared on the nineteenth day of the fever and was repeated a day or two later. Though this of itself did not appear to be alarming, his condition from that time onwards gave ground for great anxiety.

On the evening of November 20th symptoms akin to those of perforation appeared, and on the morning of Saturday, November 22nd, 1884, his earnest, eager, noble spirit entered into rest.

To his most intimate friends he had always expressed himself —like the late Canon Kingsley—as having an intense though reverential curiosity concerning the moment of death. "And now the great secret that he had craved to know was revealed to him and he was satisfied."

> "Sleepe after toyle—port after stormie seas,
> Ease after warre, death after life, doth greatly please."

The funeral took place on Friday, November 28th, the committing of the body to the grave being witnessed by troops of friends, and preceded by a simple service at St. Anne's, Highgate.

As the procession wound up the hill it was not a little touching to the associates of Mahomed's earlier years to see that the walls of the Highgate Infirmary, the scene of the labour of his earliest qualified years, overlooked those who were thus paying their last tribute to his worth.

Such is the short story of his outward life, and for Mahomed, perhaps, as much as for anyone, his outward life exhibited the workings of his mind. He seemed to deal but little in hidden meanings, and with those with whom he was intimate he was wont to speak without reserve of his anxieties, his fears and his hopes.

The work that he has done has this feature about it, that in abstract value it is all of high merit. By that we mean that quite independently of the actual observations upon which it rests it suggests or indicates fruitful lines of research. His 'Observations with the Sphygmograph,' his first published work, are now and will remain a landmark in medicine quite apart from the question of the accuracy of the deductions he drew from them, and they have unquestionably added much to our knowledge of "tension" in the arterial system and of the diseased conditions which follow its excess. Further, while, on the one hand, he lived long enough to know that the uses of his instrument were limited in their practical application, on the other he could see vistas of pathology and interpretations of disease

which his work had helped largely to bring within our recognition, and which to us now seem daily widening. After his papers on the sphygmograph, his first published work in the direction which his own observations indicated, and, we take leave to think, the most important paper he ever wrote, was on the 'Pre-albuminuric Stage of Scarlatinal Dropsy.' It was read at the Royal Medical and Chirurgical Society, and Mahomed not being a Fellow was introduced by one for whom he always evinced the greatest esteem and gratitude, Dr. Broadbent. In this paper he demonstrated what had till then been no more than well-grounded suspicion, that certain altered conditions of the circulation, high tension in short, precede the appearance of albumen in the urine. And in so doing he anticipated, and it may be said directed, the subsequent advances which have all been on the same lines, viz. those which aimed at detecting the earlier conditions which in their issues are associated with advanced structural changes in the kidney. Possibly the line of work may have been suggested to him by the observations of his teacher, Dr. Owen Rees, upon 'The Early Indications of Nephritic Irritation,' made shortly before the time of Mahomed's entry at Guy's. Much of Mahomed's work since then has been in the same direction and in harmony with the generalising doctrines concerning Bright's disease which are at present entertained, and which Sir William Gull and Dr. Sutton have done so much to promulgate. We are not surprised to find that one of his latest papers received the title of 'Bright's Disease without Albuminuria,' while at the time of his death he was a member of a committee of the Clinical Society, which is still engaged in investigating other forms of morbid urinary constituents than the albumen which is indicative of structural change.

His papers on these subjects are scattered somewhat widely through the medical periodicals of his day. As regards this his written work we feel disposed to say, that it has not yet received its full meed of appreciation, and for this reason, because it was Mahomed's work. His was a rather tumultuously teeming brain, and being so the workings of its tides inevitably produced a crest of foam which tended to obscure the wave of progress that lay behind. It is the lot of those of Mahomed's type—and in his early career he was no exception to the rule—to be freely

discounted. It is no fault of theirs that they are so; they are not the less excellent for being so. The world would be humdrum without its contrasts and its complements and there would be no progress without enthusiasm on the one hand and cautious reserve on the other. During life the enthusiastic man begets suspicion, the circumspectly wise will have a large following; but after their death the positions are reversed; enthusiasm is then felt to be the rarer gift, and its loss is to a corresponding degree more lastingly regretted. It is in this sense that Mahomed's death will leave a gap such as that of few others would have done; there is no one quite like him and few whose individuality can replace his; he was not only more widely known than many of his contemporaries, but his presence was more instant, the fire of his energy more commanding and propulsive.

And combined with the enthusiasm was a great power of sustained energy which is likely to fail in such characters as these, and no better illustration of this element can be told than his well-known labours on behalf of Collective Investigation. The idea is one which must have occurred to many. Professor Humphry, of Cambridge, gave it the first kick off, and Mahomed, catching the ball and sighting the goal, tore along in the game—it seemed almost a game to him—with an ardour which was irresistible and an organising genius which bore down opposition. And whatever may be the form of the finished work, whether it ever will be finished in the sense of being an organisation with a permanent and settled basis, no matter, Professor Humphry and Mahomed found it a shadow—it is now a substantial work; they found it a dream—it is now an act of real life. And as regards this part of his work we may well quote the words of him who was most closely associated with Mahomed. "He was the genius," says Professor Humphry, "and great supporter of Collective Investigation. The suggestions chiefly came from him and the carrying them out was in the main his. The international extension of the movement was by his wish, and he went to the International Conference at Copenhagen at much inconvenience to set it on foot and was very successful in the effort. He threw himself heart and soul into the movement, and laboured hard at it simply because he was convinced that it was a good work: good for the advancement of medical science, and good for those who would take any part in

it. He would have replied to those who doubted of its efficacy—and the chill and lassitude that ushered in his fatal illness stopped a reply which he was beginning—that they must look for no golden treasures, no startling discoveries, no new revelations as to the manifestations of disease or the methods of treatment, no redundant harvests, but that by careful tilling of the ground all over by many hands and better husbandry better crops will be sure to follow. He knew well that in such a work there must be many imperfections, many shortcomings, many failures, but his faith in an ultimate result, and his fond, cheerful, enthusiastic spirit, carried him over all difficulties and disheartening criticism and through an amount of labour that few other men would have undertaken."

Of his many other good points we can now only say that he had very little self-consciousness, and was never afraid of stating his opinions because of any adverse criticism which they might elicit. He was a painstaking teacher and always had the welfare of the medical students and their better education in his thoughts; one of his last acts before his fatal illness was to ask for, and by the kindness of Mr. Watson Cheyne to obtain, a special demonstration upon disease germs in the Biological Laboratory at the Health Exhibition for the students of this hospital. In this his constant aim to leave things better than he found them there were few things that he touched that he did not leave with added impetus in the right direction, yet of few men could it be said that, being of this mind, they have made so few enemies. Only those that misunderstood him could dislike him. And this was no doubt because, although impulsive, he was always ready to listen to reason and was certainly most easily controlled.

The friend of but yesterday can hardly be judged with that rigid impartiality which the lapse of years might allow, nevertheless, we think we shall have the assent of those that knew him in thus portraying the character of Mahomed as that of a man who spent his energy rightly, and, so far as man can judge, solely for the good of scientific medicine; who was ready with sympathy, support, and suggestion for any who were like-minded; who, while needing and hoping to live by his profession, was above the suspicion of sordid motive; who was always a fair opponent and a kindly, nay, even self-sacrificing friend,

a quick-witted physician, a bold and enterprising therapeutist, one in short whose rare good qualities marked him out, God willing, with certainty for a prosperous future and one that might at any time have flashed into brilliancy.

We, however, respected and valued Mahomed far too well to speak of his strong side only. He was indeed a man so strong in gifts, energy, and much which may be called genius as to admit of the full truth being spoken of him; his fertile imagination, his abounding energy, his unusual many-sidedness occasionally laid snares at his feet.

He was ready to ride as hobbies, some of the subjects in which he had specially interested himself; he was too apt to attach importance to one or two symptoms in a case, to the exclusion of others, and this led him to foretell, with characteristic decision and confidence, results which were not always verified. Like many other able men, he was too ready to assume a knowledge in the student which was not as yet possessed. For these reasons, as he himself often regretfully allowed, he had not yet made such way as a teacher at the bedside as the results attained by his work outside had led him to expect.

We believe this to have been mainly caused by the fact that he was over-occupied. He himself was longing to see Collective Investigation travelling on smooth ground in order that he might throw himself more entirely into his work in the wards and post-mortem room at Guy's.

It always seemed to one of the writers that there were many points of comparison between Mahomed and the late Professor Rolleston. Both were men in their prime, of fine physique; in both the cleanly-shaven face showed out strong and clear lines of features which prevented those faces from being ever mistaken for or likened to those of other men. Both were distinguished by their untiring energy, their abounding zeal, and unceasing activity of mind; both had singularly quick and fertile imaginations; both could be, and usually were, earnest and thoughtful speakers, and of both it could be said that, no one, however unprepared their speech, ever heard them talk nonsense.

Finally, both habitually detested and would, regardless of possible results, express with manly courage, often coupled

with fiery indignation, their scorn at what seemed low, unworthy or unjust, or of anything akin to meanness, trickery, or sham; both would throw themselves heart and soul into any encounter, however wearing or strifeful, out of which they believed there would be an outcome of good to their fellow-creatures.

We at Guy's who, alas, as it were but yesterday, saw Mahomed's face all alive with earnest vigour, and who know so well how habitually he strove with all his might to explore the truth, may sorrowfully recall those lines of Professor Goldwin Smith which hang beneath Professor Rolleston's portrait in the Pembroke Common Room:

SIC INDEFESSUM FACIE SPIRANTE VIGOREM
VERI ENITEBAR MENTE APERIRE VIAM
CUM VITÆ AC VULTUS NIMIO LUX VICTA LABORE EST
ET VESTRA ABREPTA EST GLORIA MAGNA DOMO.

JAMES F. GOODHART,
W. H. A. JACOBSON.

Please sign and return this Card to the Editor immediately.

August, 1886.

I have safely received Vol. XLIII of the 'GUY'S HOSPITAL REPORTS.'

POST  CARD

THE ADDRESS ONLY TO BE WRITTEN ON THIS SIDE.



The Editor of the
'GUY'S HOSPITAL REPORTS,'
36, Harley Street,
Cavendish Square,
W.

ON THE CONDITION OF THE BONES OF THE SKULL AND THE DURA MATER IN CASES OF TUMOUR OF THE BRAIN.

By W. HALE WHITE, M.D.

The object of this paper is not to record any new discovery, for the condition of the skull about to be described, is, I think, known to those who have had a large experience of making post-mortem examinations, but is not sufficiently common for its description to have crept into the text-books.

In a certain number of cases of tumour of the brain the bones of the skull will be found in the following condition: they are very light, thin, and transparent when held up to the light, which proceeding, owing to their tenuity, also shows the vessels as a most beautiful arborescent network. The thinness in the frontal, parietal and occipital bones is in extreme cases about the same as that of cardboard. There is no bone of the skull which may not be altered in this manner, but the change, if it exists, is always found in the bones of the vertex, and in extreme cases in those of the base also; thus, in one of the cases appended to this paper it will be observed that the petrous bone was affected and its abnormal thinness gave it a cribriform appearance and laid open the tympanum. There is no softening of the bone, which

remains quite hard however thin it may be, although in extreme cases its delicacy renders it possible to break it with the slightest touch. Sometimes the thinning is local, so that here and there small cavities are produced, varying in size, but not often exceeding a third of an inch in either diameter or depth. The number of these cavities is never very great.

There is not anything noteworthy about the external surface of the skull, but the interior is roughened like sandpaper. Sometimes the little prominences causing this roughening are sufficiently marked for the bone to be described as presenting on its inner surface a number of minute bony spicules with depressions between them, and in other cases a piece of unusually hard bone remains as a ridge with a depression on either side of it.

The essential characters are thus seen to be thinness and roughness of the inner surface. On looking through the cases appended to this paper it will be seen that the tenuity varies from a degree so slight that it is hardly abnormal, to one such that the bones can be easily bent, or in a more extreme case they may have disappeared altogether.

I have not included any examples in which the tumour itself has been in direct contact with the affected part of the skull, and in almost all the cases the new growth has been separated from the skull-cap by a layer of healthy brain-substance.

There can be no doubt but that this condition of the bones is the result of increased pressure within the cranial cavity. That this pressure must be enormous is easy to understand, but the calculation of its amount is a matter of extreme difficulty. As far as I am aware, the only author who has made the attempt is Wernicke,[1] but he seems to have got hopelessly wrong in his calculations, for he has employed formulæ in which the time is measured in seconds, and in the example he works out he assumes that the volume increased to three times its amount in one day. The effects of pressure which we are considering are much more comparable to the more slowly acting phenomena of which we see so many in nature, such, for example, as the irresistible force with which dry wood swells when it becomes damp. We should expect the relationship between the size of the tumour and the amount of destruction of the skull to be at

[1] 'Lehrbuch der Gehirnkrankheiten,' Band iii.

best but a rough one, for some tumours actually destroy the cerebral substance in which they grow, whilst others only push it aside. Some again cause a great increase of ventricular fluid and so augment the pressure in two ways; some, by absorbing the water in the brain-substance, alter the consistency of the medium through which the pressure is transmitted to the skull; and, lastly, some grow very irregularly, more in one direction than another, or the pressure, owing to the intervention of the falx or tentorium, gets distributed irregularly.

Unfortunately, in most of the cases collected together at the end of this paper the weight of the brain is not recorded, but in Case 2 the bones were extremely atrophied, the brain and tumour weighed fifty-nine onnces; and in Case 5, that of a boy eleven years old, the brain weighed fifty-four ounces although the tumour was only the size of a chestnut. These two extreme weights point to an increased pressure within the skull. As the attempt to get some idea of the increased pressure by noting the increased weight of the brain has, owing to the scarcity of data, been somewhat unsatisfactory, let us turn to the size of the tumour, and it will be found on going through our cases that the size was generally considerable. Thus, in the first case the tumour is described as occupying the whole of the centre of the right occipital and parietal lobes; in the third case there was a large tumour in the third ventricle and two other smaller ones in other parts of the brain; in the fourth case there was a large cyst in the cerebellum. This is preserved in the hospital museum, and from its size it is evident that the pressure must have been enormous. In each of the sixth and seventh cases the tumour was two and a half inches in diameter, and if the particulars of all the cases here recorded are gone through it will, I think, be found that the tumour is almost always of considerable size.

But not only is the size of the tumour of importance but also the amount of ventricular distension. Often in the account of the post-mortem there is no information on this head, but extreme dilatation of the ventricles was noted in Cases 12 and 14, and considerable dilatation in Cases 13, 16, and 17.

Thus, whilst, for reasons above given, it is impossible to give an exact ratio between the size of the tumour and the atrophy of the skull, we may, considering that in some of the cases the

weight of the brain is increased, in most the tumour is very large, and in some the ventricular fluid is in considerable excess, conclude that there is a rough relationship existing between the size of the new matter in the skull, be it tumour or fluid, and the degree of atrophy of the bones.

The age of the patients is interesting. It will be observed that only two were under ten, viz. a boy aged five years, and another aged seven and a half years. These are the ages at death, as it is impossible to say when the tumour began to grow. The reason why we have no examples from patients younger than this is probably because the cranial bones have not come together sufficiently to prevent their being pushed aside again under pressure from within, and thus expansion will follow as a result of intracranial pressure sooner than atrophy. This is in fact what we see in hydrocephalus, when the bones open out like the petals of a flower. But as the age increases the junction between the different bones becomes so firm that they atrophy rather than open out. In Case 8, when the tumour began to grow the cranial bones seem not to have come together, and the Wormian bones to have completely disappeared under the increased pressure.

The next question to be discussed is whether it is possible to mistake this condition for any other. I think not, for we have the tumour perfectly evident as the cause at the post-mortem examination; the atrophic condition of bones has but rarely been noted during life, and even if it were more often in all probability the case would present marked symptoms of the tumour. In Case 12 the condition produced was very peculiar and was detected during life; the bone behind the mastoid process on the right side being extremely thin and bulging externally from pressure of a tubercular mass in the cerebellum. The condition was not unlike that of syphilitic craniotabes, the bone giving on pressure; so markedly was this the case that at one time it was possible to push it in like the bottom of a conical oil-can, and the pressed bone came out again of its own accord. But it must be very rare for a local thinning of the bones to result from a tumour; more frequently the thinning is general. In no case, however, can there be any difficulty of diagnosis, for if the tumour be large enough to produce a local thinning it is sure to give rise to symptoms.

Syphilis is a very rare affection of the inner table of the skull and could easily be distinguished from the condition we are now considering.

This phenomenon of the atrophy of the cranial bones gives rise to many questions, more or less common to all examples of atrophy of bones.

One of the most obvious of these is, what becomes of the atrophied bone? In some way, no doubt, the lime salts get taken up by the vessels, and there are, I think, only two conceivable methods by which this can happen: either they must become dissolved and then pass into the vessels, or particles of lime must be taken up by wandering cells and taken into the blood. I have no original observations to record on this subject, nor do I know of any. It would be interesting to test the urine of patients in whom bone absorption was going on in order to find out whether it contained any excess of lime salts. The statement always made in cases of aneurysm in which the vertebræ have become more or less absorbed that this absorption is due to pressure, is no doubt correct, but it only tells an obvious fact. We can hardly imagine that the vessels of the wall of the aneurysm take up the bone that disappears, so we must conclude that the vessels of the bone absorb it. In these cases it is rather remarkable that the bone goes at all; it would seem that although physically very hard, and therefore one would think *à priori* difficult of absorption, yet it goes before soft structures; thus in none of the cases collected together here is there any absence of dura mater; on the contrary it is in some cases rather thick, although on the outside it has hard resistant bone, and on the inside the enormous pressure of the growing tumour. In the same way were it merely a question of physical resistance to great pressure we should surely imagine the brain-substance would be absorbed before the hard bone. Perhaps, however, this is not such a difficulty as the absence of atrophy of the dura mater, because the brain-substance may be regarded simply as a viscid fluid transmitting pressure from the centre of the cranial cavity towards the periphery.

Bearing in mind the great pain produced in aneurysm by the absorption, we might suspect that in these cases of brain tumour the pain was more extreme than in other cases, but

owing to the headache which is such a constant symptom of cerebral tumour this is a difficult point to decide.

Appended are particulars of all the cases of tumour of the brain with change in the wall of the skull that have been noticed in the post-mortem room of Guy's Hospital during the past thirty years, during which time some 13,000 post-mortem examinations have been performed. It will be seen that I have found seventeen examples : the first on my list is one of which I made the post-mortem myself; the others were made by Drs. Wilks, Moxon, Hilton Fagge, and Goodhart. The most extreme cases are Nos. 1 and 2, from which there are all grades to such a one as No. 9, in which the bones are described "as being a little thin." Guy's Hospital museum is particularly rich in specimens of this affection ; the College of Surgeons has none. To the best of my knowledge the only authors who describe it are Wernicke[1] and Birch-Hirschfeld ;[2] the reference of the latter to it is very cursory. Wernicke's description is almost an exact counterpart of the one given in this paper.

The material for giving an account of the dura mater in cases of tumour of the brain is very slight, for out of the seventeen cases it was only abnormal in two. In case No. 1 its external surface was rough like the inner surface of the skull ; it was thicker and more vascular than normal. In case No. 2 it seems to have been in the same condition, for the external surface is described as vascular and presenting a thin layer of granulations. These two cases are the two in which the atrophy of the bone was most marked, so that the probable explanation of the condition of the dura mater is that the pressure between the increasing contents of the skull and the hard wall of the cranial cavity was so great that it acted as a mechanical irritant to the dura mater and set up slight inflammatory action in it. The reason why there was not more evidence of this inflammation is that it proceeded under such enormous pressure that it was with difficulty the inflammatory products could be effused ; in fact the wonder is they ever got out at all ; probably the newly-formed granulations on the external surface of the dura mater aided the absorption of the skull by taking up some

[1] 'Lehrbuch der Gehirnkrankheiten,' Band iii, p. 262.

[2] 'Lehrbuch der pathologischen Anatomie.'

of the lime salts. Wernicke, in the work previously quoted, says that the dura mater may be thickened and often there is inflammatory action of it. So far the experience at Guy's Hospital is in harmony with what he describes, but during the last thirty years there has been no example of an atrophied cribriform dura mater, such as he says may result from the increased intracranial pressure. I have already pointed out how strange this is. Considering the enormous number of post-mortems from which I have drawn the descriptions here given the cribriform dura mater must be excessively rare; in fact one cannot help suspecting that it is mentioned in Wernicke's text-book more on account of the theoretical probability of its existence than its actual presence in any case.

It is to be observed that the slight inflammation of the dura mater manifests itself on the external surface only, so that we do not get a dura arachnitis; probably the pressure is so great that the arachnoid and subarachnoid spaces are both obliterated. The last noteworthy peculiarity is that pus is never formed.

No other membranes than the dura mater are ever inflamed as a result of pressure from tumour of the brain.

Case 1.—Walter S—, æt. 16, admitted into Stephen Ward, under Dr. Taylor, September 30th, 1884. He had sickness and frontal headache ten weeks before admission. He had been an out-patient at St. Bartholomew's and also at Moorfields for dimness of vision.

On admission.—Is weak and ill-nourished, pupils dilate; both react to light. Slight internal strabismus in left eye, can distinguish between light and dark, but cannot read the largest print. Reflexes weak; abdomen flat; tache cérébrale well marked; is dull and apathetic; the eyes show well-marked optic neuritis. On the morning of November 3rd he suddenly became comatose, blue in the face, and died in a few minutes.

I made the post-mortem five and a half hours after death.

Cranial bones.—The vertex when sawn off was remarkable for its lightness and thinness; at some parts it was quite transparent; the vessels in it could be seen as a beautiful arborescent network; in many places it was not thicker than cardboard. Its interior surface presented a most peculiar appearance, being slightly rough like sandpaper and also of a darkish

blue colour. The parts of the interior thus affected were the whole of the parietal bones, all the vertical part of the frontal bones, the squamous portion of the temporal, the occipital as far down as the attachment of the tentorium, but no further, the great wing of the sphenoid, and partly the anterior surface of the petrous portion of the temporal; there was no sign of injury (see Plate).

On taking off the skull-cap the external surface of the dura mater had a roughened appearance, very like a thin coat of lymph in an early pericarditis and also like the appearance of the inner table of the skull-cap; but nothing could be scraped off, and it was evident there was no lymph, but that the appearance was due to a slight thickening and roughening of the dura mater, which, when held up to the light, was seen to be rather more vascular than normal. The sinuses, arachnoid, and pia mater were all quite healthy.

There was a large gliomatous swelling which had destroyed the whole of the centre of the right occipital and parietal lobes, but had not implicated the surface of the brain, and therefore not the bones directly.

Case 2.—Henry W—, æt. 40, admitted into Philip Ward under Dr. Habershon with symptoms of cerebral tumour; he died on October 22nd, 1876.

At the post-mortem examination the cranial bones were found to be remarkably thin; the calvaria, when removed, had two oval, rather deep depressions on the inner surface, which had almost led to perforation at one spot. They each measured an inch by a third of an inch with the long axis forwards, and, lying on either side of the sagittal suture at the vertex they were much like what would be produced by large pacchionian bodies. On stripping off the dura mater the skull was found to be everywhere in a peculiar state. The inner aspect of the calvaria was like a sanded surface or a very fine rasp. It was quite rough to the touch; this was uniform all over. The dura mater was a little vascular on the external surface; at the base this was still more marked, so that a regular but thin layer of granulations was stripped from the bone or remained behind on the membrane as it was removed. On examining the bone surfaces themselves, one saw that in the middle fossa there was a

very large amount of erosion of the surface, and on the right side the tympanic cavity was quite laid open by the absorption of its roof. The slit thus formed measured three quarters by a quarter of an inch, and the bony surface around it was trabeculated in a most curious way from the same absorption of parts of it. There was no softening of the bone whatever. Further forwards, in the middle fossa, the floor, although smooth, was so thin that it looked as though it would soon have gone altogether. On the left side there was some roughening of bone like that seen on the roof, and the same condition was seen in the posterior fossa. All these changes were apparently due to atrophy from internal pressure.

The brain weighed 59 oz. The convolutions were flattened out and pressed together. On either side of the brain in front of the upper extremity of the fissure of Rolando was an oval swelling of brain-substance fitting into the oval depressions in the skull before mentioned. In the right occipital lobe was a greyish tumour, a glioma, an inch by an inch and a half, soft, distinct, shelling out easily from the surrounding brain-substance. The ventricles were not dilated.

Preparation in Guy's Hospital Museum 1072[54].

Case 3.—James S—, æt. 22, admitted into John Ward under Dr. Owen Rees with evident symptoms of tumour of the brain. He died on the 8th of March, 1864. At the post-mortem examination, on removing the calvaria the bones of the skull presented a very remarkable appearance on their inner surface. On taking away the dura mater they were found to be irregular on the surface and in many points to be covered with spiculæ; at the base the various ridges were extremely prominent, but the roughness here was not very great. The interior of the skull-cap was rough and prickly throughout, being covered with small bony projections between which were depressions; although some of the former appeared like new growths, yet the general characters of the skull-cap were those of wasting. It was about half the usual thickness and weight, and was in places so thin as to be diaphanous. Near the vertex there was a depression with a corresponding projection externally, and here when the periosteum was removed two or three perforations were seen. The interior of the skull-cap presented

the appearance of irregular erosion rather than the effects of an inflammatory process. The dura mater was smooth and more readily removed than natural. There was a large tumour in the third ventricle, not visible externally; there was one also in the right half of the cerebellum adherent to the bones, and there was one at the vertex; this commenced in the falx cerebri.

Preparation in the Guy's Hospital Museum 1072[58].

Case 4.—Edward C—, æt. 21, admitted into Stephen Ward under Dr. Hughes with evident symptoms of tumour of the brain. He died July 29th, 1858. At the post-mortem examination, the cranial bones were found wasted, with a very irregular surface. The interior of the skull-cap was covered with ridges and depressions; these were so deep that the bone at the bottom of them was diaphanous. The whole surface was scabious as if covered with minute bony granulations, crossing which were numerous white lines which appeared to consist of denser bone. The base was similarly affected in some parts, but particularly in the middle fossa, where the sphenoid, instead of being smooth, presented a most irregular appearance of ridges and depressions. The dura mater was slightly adherent, but not diseased; in the place of the pacchionian bodies were small holes through which the brain protruded.

There was a large cyst in the cerebellum.

Preparations in the Guy's Hospital Museum 1072[56] and 1566[30].

Case 5.—Wm. D—, æt. 11, under Dr. Moxon in Clinical Ward; died March 13th, 1883. The brain weighed 54 oz. The skull-cap was thin, atrophied, and transparent, moulded to the shape of the convolutions, so that they could be traced on the interior of it. There was a glioma of the cerebellum invading the medulla; it was the size of a chestnut; the ventricles were somewhat dilated, but not much; the convolutions were flattened.

Case 6.—Alfred W—, æt. 23, under Dr. Pavy and Dr. Taylor in Stephen Ward; died October 25th, 1883. The brain weighed 47 oz. The skull-cap was remarkably thin, and the internal surface was granular and variously mottled from

irregular blood retention in the diplöe. Dr. Goodhart, who made the autopsy, considered this condition was due to intracranial pressure, but the bone was not actually absorbed, as in some other cases. There was a large glioma of the pituitary body two and a half inches in diameter reaching in front to the olfactory bulbs, bulging over the temporo-sphenoidal lobe and extending back to the pons. The convolutions were flattened. The tumour was exhibited at the Pathological Society ('Transactions,' vol. xxxv, 1884).

Case 7.—Thomas S—, æt. 25, under Dr. Moxon in Philip Ward; died 19th November, 1883. The interior of the skull in the region of the tumour was pitted with numerous depressions as if there had been numberless pacchionian bodies there. The hole through which the growth protruded was like that produced by a large pacchionian body. The edges of all these holes were rounded and smooth. The base of the skull had its fissures and markings unduly accentuated, and all over it were numerous circular holes due to absorption from increased pressure and presenting the same smooth edges as those previously mentioned. There was a large tumour of the frontal lobe; the skull was trephined.

Case 8.—Richard M—, æt. 7, under Dr. Moxon in Bright Ward; died January 1st, 1881. The bones of the skull presented the following appearance:—The sutures were ununited, and the frontal, parietal, and occipital bones were separated by tough fibrous tissue; on the inner aspect this material stretched across the separation between the bones by bands giving the junction a fibrous or serrated arrangement, and suggesting that the usual Wormian bones had been replaced by fibrous tissue. If one might say so, they were fibrous Wormian bones. The base of the skull was healthy. There was a tubercular mass two and a half inches in diameter in the left island of Reil and left occipital region; the convolutions were distended and flattened; there was much meningitis.

Case 9.—John H—, æt. 57, was in the hospital under Dr. Habershon for symptoms of tumour of the brain, and died 17th October, 1880. The vault of the skull was a little thin; there was a glioma two inches in diameter, implicating the third left frontal convolution.

Case 10.—Mary L—, æt. 62, under Dr. Wilks in Mary Ward; died 16th April, 1879. The vault of the skull was rather thin in places. The brain weighed 48 oz. There was a glioma measuring one and a half by two inches and situated in the right frontal lobe.

Case 11.—Frances C—, æt. 48, under Dr. Wilks in Stephen Ward; died 4th May, 1879. The skull was rather thin in places. The brain weighed 47 oz. There was a tumour of the right frontal lobe.

Case 12.—Walter S—, æt. 5, under Dr. Moxon and Dr. Taylor in Clinical Ward; died November, 1877. During life there was a tumour of the cerebellum and pons two by one and a half inches behind the mastoid process; the bone over it was evidently thinned, and on being pressed in rebounded like a piece of tin. At the post-mortem examination the occipital bone on the right side over the cerebellum, and the adjacent part of the temporal, were extremely thin, evidently from intracranial pressure. They were transparent and could be indented in the same manner as during life.

Case 13.—William B—, æt. 5, under Dr. Wilks in Mary Ward; died 10th February, 1875. Calvaria excessively thin in some parts, the anterior fontanelle being scarcely more than a translucent shell of bone. There was a pint of fluid in the ventricles. A good-sized tumour was found in the cerebellum.

Case 14.—Thomas E—, æt. 24, under Dr. Moxon; died 1st March, 1875. The calvaria was rather thick, the inner surface was much roughened and had depressions which looked as though they corresponded to cerebral convolutions. There was considerable dilatation of the lateral ventricles and a syphilitic tumour in the wall of the fourth ventricle.

Case 15.—Claudius G—, æt. 7, under Dr. Pavy in Petersham Ward; died 17th October, 1872. The bones of the skull were very thin in places and rough within. There was a tubercle as big as a walnut in the cerebellum, with tubercular meningitis. The convolutions were compressed quite flat. The ventricles were enormously distended.

Case 16.—A man, æt. 42, under Dr. Rees in Philip Ward;

died 23rd December, 1869. The bones of the skull were remarkably thin and diaphanous; there were no diplöe, and the bones could easily be bent. There was a large, irregular tumour of the right frontal lobe.

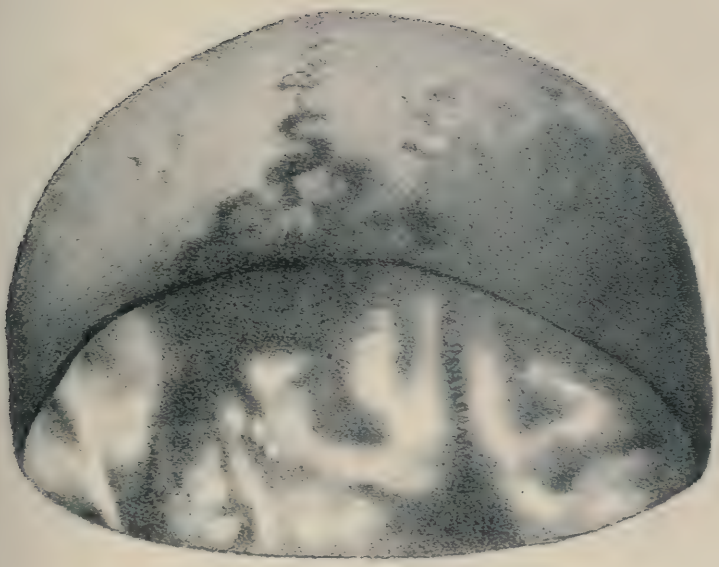
Case 17.—Wm. S—, æt. 18, was under Sir William Gull in Stephen Ward; died February 1st, 1866. The skull-cap was thin, the exterior was not notably altered, its interior was excavated by numerous shallow depressions, the deepest of which were from a third to a quarter of an inch in depth and of about the same diameter; these received bulgings of the dura mater. The bone was of a purplish red colour from great congestion of small diplöic vessels. The greater part of the right frontal lobe was occupied by a greyish tumour. All the ventricles were considerably dilated.

Case 18.—Samuel B—, æt. 32, under Dr. Barlow in Philip Ward; died 23rd February, 1862. The inner surface of the calvaria was scabious and rough; there was much ventricular fluid and a large tumour at the base of the cerebellum.

PLATE.

Illustrating Dr. White's paper On the Condition of the Bones and Dura Mater in Cases of Tumour of the Brain.

The Calvaria from Case 1.



TWO CASES

OF

STRANGULATED HERNIA IN INFANTS.

By R. CLEMENT LUCAS, B.S.

The rarity of strangulation, compared with the frequency of hernia in infancy, leads me to publish the following cases, in which it became necessary to operate in order to relieve the constriction. In one of these cases a radical cure was at the same time effected by excising the sac above the testicle and sewing up the external ring with catgut; in the other, the urgency of the symptoms left one no choice but to relieve the obstruction in the shortest possible time, and with the least shock to the patient, otherwise it is probable that (as has been my rule for several years) I should have excised the sac as part of the operation.

It has twice happened to me that I have been sent for to see cases of scrotal strangulation in infants, where taxis had been used without avail, and I have succeeded in reducing the hernia by combining *inversion* with *taxis*. I would strongly recommend that before operating the surgeon should always try the effect of holding up the child by the legs, and give a fair trial to manipulation in this position before resorting to the knife. The gravitation of the intestines towards the thorax will be found of great assistance in reducing the hernia. In the following cases taxis with inversion failed when the patient was under chloroform, and it became necessary to operate.

CASE 1.—*Strangulated right scrotal hernia, containing cæcum and vermiform appendix; operation for reduction and radical cure.*

(The case was reported by Mr. J. AYMARD, and dressed by Mr. MOURILYAN.)

F. M—, a male infant, æt. 15 weeks, was admitted on July 11th, 1885. It was a puny, miserable child, one of twins.

Soon after the child was born the mother noticed a small lump in the right groin, which grew sometimes larger and at others became smaller or disappeared. The mother has been able to reduce the swelling herself by pressure.

On Saturday afternoon, July 11th, the child was brought to the hospital with a swelling occupying the right groin and scrotum. He had been vomiting since the morning and his bowels were confined. The skin over the swelling was normal in colour but tense. There was no impulse when the child cried. Taxis was tried without success. Mr. Lucas was then sent for, and chloroform having been given, inversion and taxis were again tried, but unsuccessfully. Mr. Lucas next made an oblique incision about an inch and a half in length over the upper part of the scrotum and exposed the sac. He then examined for any constriction outside the sac, but found the rings free. The sac was then punctured, when some serous fluid escaped, and on opening up the peritoneum the distended cæcum came into view with a large swollen vermiform appendix, which latter was full three inches in length and as thick as the little finger. The neck of the sac formed a tight constriction which was divided vertically. After this the bowel was with a little difficulty reduced. When this had been effected the vas deferens was held back by an assistant, and Mr. Lucas proceeded to dissect away the sac from the top of the testicle to the internal abdominal ring. The pillars of the ring were then sewn together with green catgut, and the scrotum stitched up with four silver wire sutures.

The operation was performed under carbolic spray and carbolised gauze dressings were used. The child was ordered Tinct. Opii ♏j, Aq. ʒj, every third hour.

July 12th.—As the child appeared to be somewhat affected by the opium this was omitted and five drops of brandy were given every six hours.

13th.—The wound was dressed for the first time and was found to be doing well. Temperature normal.

15th.—The wound was dressed and the stitches removed. The child was ordered Sp. Chlorof. ℥iij, Sp. Rect. ℥v, Aq. Anethi ʒj, 6tis horis, and the brandy was omitted.

18th.—The wound was found quite healed, leaving a scar about an inch long. There is no tendency for the hernia to come down. The child has greatly improved in health.

26th.—The child was sent out to-day, the wound being quite firmly healed and the child in much improved health.

Remarks.—The advantages of excising the sac of a hernia are twofold. It contributes to the attainment of primary union after an operation for strangulation and it assists in obtaining a radical cure. The sac of a hernia is ill supplied with blood and after being opened is liable to suppurate and to keep up an opening into the peritoneal cavity. Excised, the danger of suppuration and consequent peritonitis is almost certainly avoided. These remarks apply nearly absolutely to cases of femoral hernia and to cases of acquired inguinal, but some reservation must be made in regard to congenital cases because in these the sac cannot be completely excised without destruction of the testicle. The portion corresponding to the tunica vaginalis must be left and the operation cannot be regarded as complete. When the sac of a hernia has been excised raw flesh surfaces are brought into contact and adhere from the peritoneum to the skin, so that if nothing has been introduced at the time of the operation to excite suppuration primary union may be regarded as certain. If the rings are large these may be closed by green catgut, which is cut short in the wound, and which will not, if properly prepared, excite suppuration. For several years now I have excised the sacs of all the femoral herniæ I have been called to operate upon and I should consider the operation incomplete were this not done. This has had a very marked effect upon the success of my operations and on the time a patient is required to rest after the strangulation. Uncomplicated cases I always allow to get up for a short time on the sixth day, and they leave the hospital with a truss on the fourteenth day. This is a vast improvement on the old plan of keeping them in bed for a month or six weeks.

CASE 2.—*Strangulated left inguinal hernia; operation; recovery.*

A. G—, a male child, æt. 2 years, was admitted into the Evelina Hospital for Children on November 21st, 1883. The hernia was supposed to have been down about three days, and the child when admitted was in a very weak state. There was a large scrotal hernia, tense and devoid of impulse. The vomiting was stercoraceous and the pulse very weak and bad. Taxis having failed he was given chloroform at once and careful taxis and inversion tried without success. Mr. Lucas then, under spray, cut down and exposed the sac. The external abdominal ring was divided, and the tumour was then returned without opening the sac. The child was taking chloroform badly and the operation was rapidly completed, the wound sewn up with silver wire and carbolic dressings applied. After he had recovered from chloroform he was given three drops of laudanum.

November 22nd.—He slept well, and has had one natural motion.

23rd.—He was dressed for the first time. Temperature normal.

The wound healed by primary union.

The temperature on no occasion rose above normal, and at the end of the seventh day the child was well.

After being up for about a week he caught cold and had rather a severe attack of bronchitis, in consequence of which he was kept in the hospital until January 6th, 1884.

Remarks.—The foregoing case is only remarkable for the rapid reaction and recovery which took place as soon as the child was relieved from the strangulation of its intestine. He was admitted very weak and prostrate and fell into a most dangerous state of collapse under chloroform. Hot bottles, flannel, and brandy injected subcutaneously brought about a reaction, and then, being able again to take nourishment, he made one of those springs towards recovery which are peculiar to the age of childhood. The wound healed primarily and the hernia gave no further trouble, but after he had been about for some time he unfortunately caught a severe cold, on account of which he was kept in until after Christmas.

THE PATHOLOGY

OF

EXTRAVASATION OF URINE

AND OF

SACCULATION OF THE URETHRA AND BLADDER.

By W. ARBUTHNOT LANE, M.S.

The descriptions of the process by which urine escapes from the urethra into the surrounding tissues in extravasation are, as a rule, tolerably clear and definite, but they convey to one's mind a condition of things which I have been unable to verify by careful examination of the parts after death. I will first give an example of one of these descriptions, and will then venture to criticise it and state my case. Sir Henry Thompson in his article in 'Holmes's System,' writes as follows: "Extravasation of urine takes place during unrelieved retention by the giving way of the urethra at some point. It is very rare indeed that the bladder itself is ruptured. In either case, however, mechanical distension is not the direct or only cause. *Ulceration* of the mucous membrane behind the stricture leads to a breach of the urethral walls. The bladder contracting drives the urine with great force into the cellular spaces around, so that it soon reaches the superficial fascia of the scrotum, abdomen, &c."

By this I think one would understand that the mucous membrane of the urethra behind the stricture ulcerates, that this ulcerative process extends through the wall of the urethra till the floor of the ulcer is sufficiently thin to yield to the force

exerted on it by the urine. The urine then escapes into the areolar tissue beneath the deep layer of superficial fascia. He does not state definitely in what way the urine passes through the thick layer of corpus spongiosum intervening between the floor of the urethra and the connective tissues surrounding the bulb, when, as is usual, extravasation takes place in this region. He might possibly wish one to suppose that the ulcer extends through the corpus spongiosum as it does through the urethral wall; that rupture of this deep ulcer does not take place till it has reached the outer limit of this structure. Other surgeons state that the dilated urethra may rupture without the presence of any ulceration of the mucous membrane. I imagine that this could only apply to the membranous portion. I have been unable to find any definite account of any of these conditions in the Transactions of the societies. In none of the numerous specimens of stricture of the urethra, with or without extravasation which I have examined, have I succeeded in finding any ulceration of the mucous membrane producing destruction of the wall of the urethra, as described by authors. Again, he writes in the same article: "If the extravasation have taken place between the two layers of the deep perineal fascia, a firm, hard, deep-seated swelling may sometimes, but not always, be detected in the perineum, and should at once be freely opened. If it occur behind the fascia altogether—but this is very rare—the urine finds its way around the base of the bladder, and a fatal result is inevitable."

I will first describe the conditions I have frequently found in the prostate, bladder, and urethra in old cases of stricture, and I think it will then be seen that these conditions are such that extravasation of urine into the loose connective tissue may take place at any moment if undue pressure be thrown upon the parts owing to some increased obstacle to the passage of urine through the stricture, or to any sudden and violent action of the bladder and abdominal walls. To illustrate my point, I will give an account of the appearances presented by one of these cases, as it shows in a marked manner many of the changes which favour extravasation.

C. O—, æt. 71, was admitted into Guy's Hospital suffering from necrosis of the fibula. Mr. Davies-Colley removed several sequestra. He was in the hospital about seven weeks. He was

said to have had syphilis when he was seventeen years of age. He did not complain of having had any difficulty in passing his urine, nor of having felt any pain or discomfort in the perineum during micturition or defæcation, either before his admission or while he was a patient in the hospital. No albumen was found in his urine. On one occasion a deposit of pus was observed in it. He died quickly and unexpectedly within an hour or two from the onset of his fatal symptoms.

At the post-mortem examination both his kidneys were found to be coarsely granular, especially the left, which was very small. The pelvis of the kidney was not dilated, nor were the papillæ flattened.

The ureters were not dilated. In the lower part of their extent their walls were thicker than normal. The bladder was not dilated, but its wall was very thick. Its mucous membrane did not show any tendency to the formation of sacculi. (Their absence in such a case as this is unusual. I ascribed it to the remarkable toughness of the muscle wall of the bladder.)

The prostate was large and soft, forming a mass which extended downwards and forwards beneath the membranous urethra, where it had displaced, or was closely adherent to the triangular ligament, or its remains, as at this point it now only formed a part of the wall of an abscess cavity. On opening the urethra, pus welled out freely from two or three minute openings in either prostatic sinus. These led into large abscess cavities in either lateral lobe of the prostate, which did not communicate with one another. They had distended the prostate, extending downwards and forwards, involving the posterior layer of the triangular ligament, the walls forming their anterior limit being very soft and thin, so much so that a very slight force applied here would have easily led to their rupture, and to the escape of the contents of the cavity. The sinus pocularis was much dilated, allowing the passage of a large probe. The walls of the vesiculæ seminales and vasa deferentia were hypertrophied, but their cavity was not appreciably dilated. The membranous urethra was enormously dilated, so as to form a short fusiform channel the greatest circumference of which measured two and a half inches. Its walls were thick. Converging to its anterior extremity were numerous

longitudinal folds of mucous membrane, which was not ulcerated. The stricture affected the posterior one and a half inches of the bulbous urethra. Its channel was small and very irregular. The urethral mucous membrane in front of the stricture was superficially scarred almost up to the external meatus. The calibre of this portion of the urethra was small and the wall thicker than usual. The bulb was much enlarged and extended backwards so far as to touch the anterior portion of the prostate. Opening into the strictured urethra at its back part were several small orifices which led directly into a large abscess cavity in the bulb which it had dis-

Fig. 1.



tended. The cavity was two and a half inches long, and the abscess wall formed by the bulb was very thin and soft anteriorly. The normal appearance of the bulb where it formed the wall of the abscess cavity was quite lost, owing to the presence of inflammatory products in it. Any strain thrown upon the abscess cavity in the bulb would have resulted in the rupture of the thin soft wall and in the extravasation of urine beneath the deep layer of the superficial fascia of the perineum. As in this case, I have frequently found large abscess cavities in the perineum or prostate in communication with the urethra without the patient having made any complaint of pain or discomfort

in this region, so that it cannot well be urged against the hypothesis that the wall of an abscess cavity in communication with the urethra ruptures, that the patient has suffered no symptoms indicative of suppuration in this region.[1] In Fig. 1, I have attempted to delineate the appearances described above. The section has passed to one side of the verumontanum so as to go through one of the abscess cavities in the lateral lobe of the prostate. If no strain had been thrown upon the abscess cavities in the prostate and bulb, the continuance of the inflammatory process would have resulted in a gradual adhesion of the superjacent structures and the extension of the cavity to the surface and in the formation of perineal fistulæ. The pressure exerted on the soft walls of these abscess cavities if urine be forced into them through their small openings of communication with the urethra must be enormously disproportionate to their power of resisting it, and easily accounts for their rupture. The conditions presented by the bladder, urethra, and the communicating cavities before any rupture has taken place are closely analogous to those presented by a sacculated aneurysm, with a small orifice of communication with the artery upon which it is situated. As it bears on this analogy, I will first point out what appears to be a fallacy in Mr. Holmes's explanation of the mechanism of rupture of a sacculated aneurysm.[2] Mr. Davies-Colley called my attention to it. Mr. Holmes describes a sacculated aneurysm as being analogous to the hydrostatic paradox, and says that in that instrument "the smaller the opening in the bellows the greater is the pressure on its walls," also, "In every aneurysm properly so called, as distinguished from a mere dilatation, the pressure on the wall is much greater than the natural pressure of the heart;" and, again, "In a fusiform aneurysm in which the orifices of exit and entrance are free, the lateral pressure upon the sac cannot be severe. Hence these aneurysms enlarge slowly and do not burst readily." Surely the blood-pressure exerted on the same area of an undilated large vessel, and upon the same area of a fusiform aneurysm, and of a sacculated

[1] On more than one occasion I have known pus from a chronic perineal abscess, the presence of which was unsuspected, gives rise to serious errors of diagnosis and prognosis.

[2] 'Holmes's System,' vol. iii, p. 30.

aneurysm in the same subject, is almost exactly identical, and, in the last case, independent of the size of the orifice of communication. It is difficult to understand how the pressure on the same area of the sacculated aneurysm could be increased beyond that exerted by the blood upon the same area of the vessel with which it communicates, and how it could vary in the former in proportion to the size of the orifice of the dilatation according to his argument. The rate of progress of a sacculated aneurysm certainly varies with the size of the orifice of communication, but for the reason that the smaller the orifice of communication with the vessel the sooner does the original vessel wall cease to form a part of the sac wall, its place being taken by structures less able to resist the pressure of the blood. Consequently, sacculated aneurysms increase rapidly and soon burst. The changes that take place in the three equal areas of undilated vessel, dilated vessel, and sacculated aneurysm depend on the different capacities for resisting pressure possessed by these areas, and that capacity is less in the case of the sacculated aneurysm which has lost nearly all, if not all, the original coats of the vessel, than in that of the fusiform dilatation which probably retains them all, or nearly all, though in an impaired condition. In a case of bad stricture in which the bladder is hypertrophied and sacculated and the urethra dilated and in communication with abscess cavities, the pressure exerted on equal areas of wall, whether of sacculus, bladder, dilated urethra, or abscess, by the contained fluid is the same, but the capacity of each area to resist pressure varies in each case. One cannot draw a conclusion solely from the examination of the thickness of the wall, since other factors step in, as the intra-abdominal pressure in the bladder and sacculus, &c.

The relative capacities of resisting pressure possessed then by these several parts will be seen from an examination of the cases I will describe. Rupture of the wall of a sacculus of the bladder is very rare. This will be seen by an examination of the six cases collected by Mr. Rivington, and described in his very careful work on the subject.[1] All these cases suffered from obstruction occasioned by hypertrophy of the prostate. In five of them that portion of the bladder which is covered

[1] 'Rupture of Urinary Bladder.' Rivington.

by peritoneum presented the rupture. He sums up his results in the following words: "The sequence of events in this class of ruptures is hypertrophy of the prostate, chronic obstruction to the flow of urine, straining, hypertrophy of the muscular fibre of the bladder, formation of tunicary herniæ, thinning of the fundus, attack of retention, rupture of a diverticulum with or without previous ulceration or sloughing." The description of the pathological conditions in some of these cases is not as thorough as one would wish. Mr. Field's case[1] is, however, a good example of the injury. The peritoneal opening was near the middle of the superior fundus of the bladder, and admitted a sound. The edges of the opening were smooth and rounded, as if a portion of the bladder wall had become sacculated and had given way, the peritoneum rupturing subsequently. This limitation of the seat of rupture to the surface of the bladder covered by peritoneum is due to the fact that sacculation, in the large majority of cases, only affects this portion of the wall of the bladder. This will be seen from the descriptions of my cases; also that it is usually present in cases of urethral or prostatic obstruction of long standing.[2] The reasons that these sacculi do not rupture under pressure as readily as do those in the perineum are that the sacculus is supported by the pressure of the adjacent viscera, and that their orifices of communication with the distended bladder are both absolutely and relatively very much larger than those in connection with the urethra. I will now describe those cases of extravasation which I have dissected, and they will be seen to present all the conditions I have already mentioned as being present in old-standing cases of stricture, and I hope to show that in some of them extravasation has taken place in the manner I have indicated.

[1] 'Med. Times and Gazette,' Dec. 13th, 1856. Field.

[2] The largest sacculus that I have yet examined was not covered by peritoneum. Its orifice was three quarters of an inch in diameter, and its centre was situated an inch in front of, and half to three quarters of an inch above, the internal orifice of the left ureter. It was almost as large as the bladder. There were many smaller ones in their usual position. I have also noticed that herniæ in the immediate vicinity of the attachment of the urachus have a very thin covering of muscular tissue. In some cases it was imperceptible. In over-distension of the bladder, sacculi in this position would be more likely to yield than those lower down.

In the *first* case I found the stricture to be situated one inch in front of the anterior layer of the triangular ligament. It was half an inch long and impermeable to any probe we had. The urethra in front of the stricture was narrowed and its wall apparently thickened. The corpus spongiosum immediately around the stricture was converted into a fibrous mass in which there was hardly any appearance of spongy tissue, but in front of it this portion of the penis was quite normal. The bladder was dilated, and its wall enormously hypertrophied. On the left half of the upper wall of the bladder were two small openings leading into cavities in the thickness of the muscle, each of which would contain a pea, their roof being formed by peritoneum and a thin layer of muscle-fibre. They did not form any prominence on the outer surface of the bladder unless they were distended. The prostate was not hypertrophied, but was flattened, its margins being ill defined, so that it would have been very difficult to define its limits by the rectum. The prostatic and membranous urethra and the part of the bulbous urethra not in the immediate vicinity of the stricture were considerably dilated. The portion of the canal just behind the stricture presented in its interior a number of longitudinal ridges which converged to the stricture. A small opening in the mucous membrane of the floor of this part of the urethra led into a narrow channel about an inch and a quarter long which ran backwards, terminating in the substance of the prostate in a rounded and somewhat dilated extremity about a third of an inch beneath the urethra. Three quarters of an inch behind the stricture were two small openings in the floor of the urethra with smooth edges. They opened into an oval space about half an inch long and well beneath the mucous membrane and wall of the urethra. Opening into the floor of this cavity was a small narrow channel which ran directly downwards into the perineum for a distance of three quarters of an inch. This became dilated at its termination, where it ended in a sloughing cavity which was apparently the seat of extravasation. There was the remains of a cavity at the end of this sinus, which was evidently of some standing, as its wall, which was one third of an inch thick, was dense and cartilaginous on section. There was no sign of any superficial ulceration of the mucous membrane of the urethra behind the stricture. The

first described cavity with the orifices of communication with the urethra had evidently contained urine for some considerable time as it was lined by epithelium continuous with that of the urethra. From the description it will be easily seen that this cavity was not produced by a process of ulceration of the mucous membrane and its gradual extension outwards. It probably commenced in the connective tissue and opened into the urethra, and extended outwards into the perineum. Its original seat may, however, have been in the wall of the urethra in a gland, or in the tissue immediately adjacent to it, or outside the bulb in the seat of extravasation. This case then bears out the hypothesis I put forward.

These physical conditions also explain the mode of formation and the progressive increase in size of sacculi from the urethra or bladder, whether they originate in the bladder wall, as they usually do by a hernial process of its mucous membrane, or as an abscess which has opened into the bladder or into the urethra behind a stricture, as in the next case, and in one described by Dr. Hale White.[1]

This second case of extravasation, which had been under the care of Mr. Davies-Colley, presented many appearances similar to those described in the last case, and explicable in the same manner. The stricture affected the urethra two inches in front of the anterior layer of the triangular ligament. It had been very freely incised at the time of the operation, so that I was unable to discover in what way urine had escaped into the loose connective tissues. The urethra behind the stricture was much dilated and its wall thickened. There was no ulceration of the mucous membrane lining it. Beneath the floor of the bulbous urethra and to the left of the middle line was an irregularly branched and tortuous space, with thick firm walls. In no part did it dilate to form a cavity of any size. It opened into the urethra by three small rounded orifices, large enough to admit the end of a small probe, and it extended for more than half an inch into the indurated tissue beneath the wall of the urethra. The extent and tortuosity of these cavities was not apparent till transverse sections were made at short intervals through the urethra, bulb, &c. As in the last case, there was a channel one and a quarter inches long running beneath the

[1] "Sacculated Bladder in a Female," 'Trans. Path. Soc.,' vol. xxxiv.

mucous membrane and ending blindly in the substance of the prostate. A quarter of an inch in front, and a little to the right of the opening of the sinus pocularis was a small foramen with a free, rounded margin, large enough to admit the round end of a small surgical probe. The probe passed into a cavity of some considerable size, and on compressing the prostate urine escaped freely from this opening. On separating the bladder from the rectum a large mass was seen to extend up behind the bladder on both sides, but more so on the right side. On cutting into this an oval cavity was exposed the general direction of which was obliquely upwards and to the right. It was two inches long by one and a half broad, and presented the appearance of a small urinary bladder, in its lower part being quite smooth, while above it presented a fasciculated appearance. Its wall seemed to consist only of involuntary muscle-fibre and to contain no remnant of glandular tissue. Its lining membrane was smooth and covered by epithelium, which was continuous through the minute opening with that lining the prostatic urethra. It was in no part inflamed. The opening was situated in the roof of the cavity, three quarters of an inch behind its anterior limit, which extended forwards as far as the posterior extremity of the bulb. At the upper and right extremity of this cavity there was another triangular in form, which seemed to be a diverticulum from the larger. It was about three quarters of an inch in length. It was crossed by a network of trabeculæ of muscle-fibre, and it communicated with the larger space by a foramen, a quarter of an inch in diameter. It was thin and dense below, but above was thick and spongy, resembling coarse erectile tissue, the trabecular network being here very close. Communicating with the left side of the large cavity about its centre by a similar small opening was another secondary cavity, one and a quarter inches long. This passed upwards and to the left, crossing over the left vesicula seminalis and both vasa deferentia. This cavity was crossed by a much closer trabecular network, and in this manner a structure was produced similar to the last, except that at points of this sac the wall was very thin indeed, so as to lead one to suppose that rupture of this thinned portion might easily ensue if the pressure within the sac were considerably increased by some violent expulsive

effort.[1] There was a plexus of enormously dilated veins in the areolar tissue surrounding these prostatic diverticula. During the contraction of the greatly hypertrophied bladder on its contents there must have been a great increase in size in these saccular dilatations. In the roof of the prostatic urethra was another opening leading into a small, irregular cavity in this portion of the prostate. It resembled in structure one of the secondary diverticula from the large prostatic sacculi. There was no inflammation of the lining membrane of this cavity, which was smooth and shiny.

In the upper extremity of the bladder, at the point of attachment of the urachus, was an opening about an eighth of an inch in diameter. This led into a sacculus large enough to hold a small marble, which when distended produced a considerable prominence on the outer wall of the bladder. It consisted of mucous membrane with a very thin covering of muscle-fibre. Just beside it were two similar openings leading into smaller cavities in the thickness of the muscle wall of the bladder. I do not think there can be the least doubt that the cavity opening into the prostatic urethra was originally an abscess in the right lobe of the prostate, which had burst into the urethra. During the straining efforts to empty the bladder urine was forced into the abscess cavity, and this was partly expelled from it after the expulsive efforts of the bladder had ceased by the elastic pressure of the tissues surrounding the sac. By this means it was kept continually flushed by an intermittent flow of urine into it, and gradually it became lined by an epithelial covering continuous with that of the urethra by its extension through the orifice of communication, in the same manner that epithelium extends along the channel produced by Cock's operation. The very great pressure inside the sac caused it to increase and to form secondary diverticula, and caused the destruction of the glandular tissue in its walls. I do not think that this is a very uncommon result of prostatic suppuration, though the cavity in this case is much larger than usual. Others will be described in subsequent accounts.

Under the head of "Cysts of the Prostate" Sir H. Thompson says it is not at all uncommon to find cavities of an irregular form

[1] This specimen is now in the Pathological Museum of Guy's Hospital, No. 2398[5].

in its substance, which are not met with in the normal organs that they have all the appearances of being dilated follicles of the glandular tissue, and that they frequently contain numerous concretions. He considers that the formation of these cavities or cysts depends a good deal on the prior formation of concretions. He also says the prostate after long long-continued suppuration is sometimes converted into a kind of cyst or membranous bag which can in no respect be regarded as a form of cystic disease. The organ he describes as having in fact disappeared, and its capsule forms part of the sac of an abscess which has replaced the normal structures.

I would point out that in the condition to which I refer, the cavity can be no longer regarded as an abscess cavity, as its wall no longer secretes pus, and now merely forms a receptacle for a portion of the contents of the cavity with which it communicates. I cannot agree with him either when he states that the cavities he describes in the prostate are always produced by the formation of concretions, as they are usually empty; besides concretions may form secondarily in the cavity as in sacculi in the bladder wall. I do not mean to say that calculi are not uncommonly formed in the ducts of the prostate, where by their gradual increase in size they cause a corresponding dilatation of the duct, and even in some cases the absorption of the tissue between adjoining concretions, and the final conversion of the prostate into a bag of concretions. I think that this is the less common mode of origin of spaces in the prostate. I do not find any description anywhere of this sacculus formation produced by the flushing of a prostatic abscess by urine under considerable pressure which keeps it from contracting, and soon alters the character of its wall and lining membrane.

Evidently to prevent the escape of fæces during the violent expulsive efforts made to expel the urine through the stricture the internal sphincter ani had become enormously hypertrophied, being an inch and a quarter deep, and more than one third of an inch thick. The recto-coccygeal muscles were also enormously developed. A number of external and internal piles were also present.

In the third case, which was a patient of Mr. Golding-Bird's, there was a large slough on the lower part of the scrotum, but

the inflammation had not extended to the penis or abdominal wall. Cock's operation had been performed, and the patient had died rather suddenly about a week after the operation. The wall of the bladder was very thick and was free from fat. On its upper wall, immediately behind and to the right of the attachment of the urachus, was a small opening leading into a cavity in the wall the outer boundary of which was formed by peritoneum and a thin layer of muscle-fibre. This cavity on being distended formed a rounded prominence on the outer aspect of the bladder. At points half an inch, and again an inch and a half below this were two similar cavities as large as the first. In the neighbourhood of them there were several smaller depressions of the mucous membrane. The stricture was situated an inch and a quarter in front of the triangular ligament. It was more than half an inch long and admitted a fine probe. The urethra in front of it was narrowed, and its wall was thicker than normal. The urethra behind the stricture was much dilated, its wall thick, but its mucous membrane not ulcerated. There was a large abscess cavity in the perineum with a thick granulating wall. The membranous urethra lay in the upper wall of the cavity together with the under surface of the prostate. Whether the latter was only stripped of its capsule at this point, or whether the abscess had arisen in the outer part of the prostate, was uncertain, though the latter appeared more probable. The levator ani was seen in the outer wall of the abscess; it was much hypertrophied and its bundles of fibres formed columns projecting into the cavity. The knife had passed through the floor of the cavity and then through the prostate, opening the prostatic urethra close to the neck of the bladder. There were no remnants of the posterior layer of the triangular ligament. There was a good deal of thickening and inflammation of the tissues surrounding the abscess cavity, the wall of which was quite intact, except where it had been incised. There was no ulceration of the mucous membrane behind the stricture, nor was I able by the most minute examination to find any communication between the urethra and the abscess cavity. The ducts of Littré in the dilated urethra were elongated and dilated. The thickness of tissue between the membranous urethra and abscess cavity was only an eighth of an inch. There were several dilated prostatic

ducts which ended blindly, and did not possess any terminal dilatation. On looking at the clinical history I found that the man had suffered from some difficulty in micturition for some considerable time, but it was only within the last fortnight before the operation that this difficulty suddenly became extreme.

The question now arises as to what was the origin of this abscess. It certainly did not present the usual appearance of a case of extravasation, as there was no apparent escape of urine into the surrounding tissues, with extensive, continuous, very acute inflammation. The abscess was not situated in the usual seat of extravasation, being behind the anterior layer of the triangular ligament. Was this an instance of extravasation from the membranous urethra? Though the wall of this portion of the urethra was quite free from ulceration and apparently quite intact, when one considers how much urine will pass through a stricture through which one passes the smallest probe with difficulty, one need not be surprised that a considerable quantity of urine should pass into the surrounding tissues through the rupture of one of the enormously dilated ducts of Littré. As I said, I was not able to trace one quite into the abscess cavity, but the inflammation produced secondary to the rupture might easily have occluded it. Or was this an abscess which had formed beneath the floor of the membranous urethra dilated behind the stricture, as we have seen them form in front of the triangular ligament, and which might have opened into the membranous urethra, and have been then possibly followed by rupture of its wall and extravasation of urine?[1] Or was it an abscess which had commenced in the lower part of the prostate, and extended forwards, destroying the posterior layer of the triangular ligament, and exposing the membranous urethra and compressing it? Considering the great difficulty of accurately stating the mode of origin of this abscess after death, the clinical problem was relatively a very complex one. A strong point against extravasation in its usual position was the non-extension of the inflammation to the penis and abdomen, yet this

[1] In this case the abscess may have originated in the connective tissue in the vicinity of the dilated urethra, or in one of the submucous glands which had suppurated, or in one of Cowper's glands the duct of which had become occluded by the inflammatory induration forming the stricture.

would not serve to have distinguished it from extravasation behind the anterior layer of the triangular ligament.

In the fourth case a fine staff had been passed through the stricture, which had then been freely divided by an external incision. Mr. Howse, under whose care this patient was, considered that he was suffering from an erysipelatoid condition of the scrotum and perineum and acute septic absorption, and that this was due to the very energetic catheterisation to which he had been submitted before his admission, in an almost dying condition, into Guy's Hospital. The stricture was situated two inches in front of the anterior layer of the triangular ligament, and was freely divided in its whole extent. The bulb around it was dense and indurated. The urethra in front of it was narrowed. Surrounding the bulb was an extensive slough, which exposed the corpora cavernosa, and its appearance differed not at all from that usually presented by extravasation. The urethra was dilated behind the stricture, and immediately behind the constriction were the openings of two small sinuses, which were directed downwards and forwards. The upper part of these sinuses was patent, and admitted a small probe for nearly half an inch, but beyond that the sinus was continued on as a solid dark rod, which was lost in the slough. The appearance presented was as if a small abscess had formed in the tissues about the stricture, and had opened by two small sinuses into the urethra behind the stricture and during straining this cavity had yielded to the hydraulic pressure. The closure of the lower part of the sinuses is accounted for by the fact that they were involved in the intense inflammation. The bladder was very much hypertrophied, and there was little or no fat in its wall, which was dense and firm. There was a small sacculus situated half an inch behind a point midway between the orifices of the ureters, just below the peritoneal limit. It was as large as a marble. There were two smaller ones in the immediate neighbourhood. This case again shows not only that the greatest difficulty exists in making an accurate clinical diagnosis of the existence of actual extravasation, but that it may be quite as hard to trace the cause of the condition on the post-mortem table. I think that the result of the examination of the parts after death renders it more probable that the erysipelatoid condition was secondary to the rupture of a small

abscess cavity in communication with the urethra, and the extravasation of a small quantity of urine into the tissues surrounding it.

The next case was M. R—, æt. 40, who had suffered from stricture and occasional attacks of retention for some years. He was admitted into Guy's Hospital under Mr. Golding-Bird with extravasation. Cock's operation was performed and free incisions were made. The patient died three days after admission.

The kidneys weighed 13 oz., and were apparently quite healthy. The bladder was contracted to the size of a Tangerine orange, its walls were thick and there were no sacculi of any size in it, except one about as large as a small marble just above and to the left of the opening of the left ureter. The wall of the bladder was tough and free from fat.

There were two or three dilated prostatic ducts in either sinus. There were two strictures, one just behind the glans and another an inch and three quarters in front of the anterior layer of the triangular ligament. The urethra behind the stricture was dilated. In its floor near the posterior limit of the bulb was an oval opening with free smooth margins leading into a cavity as large as a nut. The wall of this cavity was smooth, and apparently possessed an epithelial lining. In the floor was a rent the margins of which were sloughy, and this slough was continuous with and appeared to be the starting-point of the gangrene. As well as this opening into the urethra, there were many others in the bulbous and membranous urethra which communicated with irregular cavities in the neighbourhood of the urethra, any one of which might have ruptured under an increase of pressure on their contents. The orifice of the cavity that ruptured was both relatively to the size of the cavity, and absolutely, larger than any I have yet seen in this position.

I think that, in the cases we have examined, there is no doubt that extravasation, when present, did not take place from a rupture or an ulceration of the mucous membrane of the urethra; also that when abscesses opened into the urethra they did not usually originate in an ulcer of the mucous membrane, but developed in the prostate or tissues about the dilated urethra in much the same way, and owing to the same causes, that ischio-rectal abscesses develop in obstruction to the passage of

fæces in organic stricture or in habitual constipation. The course taken by these abscesses is very similar.

Cavities similar to that resulting from a prostatic abscess in Case 1 are also found in the female subject. Mr. Lawson Tait has recently published a short paper on the subject in the 'British Medical Journal,' May 16th, 1885. In this he refers to five well-marked cases of sacculi requiring operation. One of these was reported by M. Gillette, of Paris, and four were under Mr. Lawson Tait's care. I will quote a portion of his communication: "In M. Gillette's paper he alludes to several cases in which general or what may be called ampullary dilatation of the urethra has been met with requiring operation. But, so far as I know, nothing of the kind has ever occurred in my own practice. The only dilatations of the urethra that I have ever seen are the four now placed on record, and the fact that in every one the feature of an extremely small aperture communicating between the sac and the urethra was established makes it clear that in these four cases, and probably I may say also in M. Gillette's as a fifth, we have a distinct form of disease, the origin of which is open to one of two explanations. The first, and I think the most likely of these is that there is as the origin of this condition, an error of development by which a small offshoot of the urethra, like a diverticulum of intestine, is the result of faulty union of the primal folds, and that this becomes of pathological importance when women become accustomed to those errors of urination to which they are all more or less addicted. The second explanation is that this urethrocele is formed by the union between the urethra and a cyst of pathological origin in the roof of the vagina. But I am disposed to regard the former as the more likely of the two, from the extraordinary similitude which all my four cases have presented, and from the fact that I have never seen any cysts at all like them in a position that such a communication with the urethra might take place." I have given the above in full and would refer the reader to Mr. Tait's description of his cases in the same paper, so that he may compare the conditions there related with those I described in connection with the male urethra. There also we have a cavity in communication with the urethra by a minute orifice, and being distended with urine. There must be a considerable pressure in the female urethra

during micturition, otherwise urine would not enter and distend the sacculus. The condition is perfectly analogous to the sacculus in the first of my cases of extravasation, which had increased in size in the direction of least resistance, viz. upwards and backwards in the loose tissue between the bladder and rectum. Considering this, I would add to Mr. Lawson Tait's two suggestions a third, and I venture to think the most probable one, since it is the most simple of the three. It is that these sacculi originated in an abscess which had formed between the bladder or urethra and vagina, or even in the lower part of the broad ligament. This opened into the urethra, and was flushed during micturition. After a time the pus-secreting character of its lining membrane was lost, and an epithelial lining extended over its surface from the urethra through the foramen of communication, and a definite sacculus was formed. The conditions of the parts in the female subject are more favorable to the formation and development of a sacculus than they are in man as there is less resistance to its growth, owing to the laxity of the tissues.

I will now mention a few points in connection with sacculi of the bladder and the circumstances that affect their formation and increase in size. In very rare cases, as in that described by Dr. Hale White and referred to before in this paper, they originate in abscesses in the neighbourhood of the bladder. Among the number I have examined I have not found one that was formed in this way, nor have I seen an abscess form in the bladder wall, though I have seen one of the hernial diverticula suppurating and discharging pus. As a rule, they are produced by a protrusion outwards of a process of the mucous membrane into or through the muscle wall of the bladder. Immediately beneath the level of the general surface of the mucous membrane the sacculus dilates to form a cavity in the thickened wall, much larger than the orifice of communication, while if it extends beyond the outer surface of the bladder, it dilates still further, and as it increases in size, it retains a coat of muscle-fibre the thickness of which bears an inverse proportion to the size of the sacculus. The sacculi are in the great majority of cases limited to the upper wall of the bladder and to the base above the level of the openings of the ureters. This is due to the fact that this portion of the bladder does not receive the

firm support that the rest of it does from bone and muscle. The sacculi may reach a very large size before the peritoneum is at all intimately blended with their coats, especially when they are situated in the upper part of the base of the bladder. These last especially very frequently escape notice on the post-mortem table, as even when very large, owing to their possessing very thin flaccid walls and to their being separated by loose areolar tissue from the peritoneum, they produce no prominent firm mass, and their orifice of communication is often very small indeed. In some old-standing cases of stricture even when the bladder wall is very thick, there is no sign of sacculation. In these cases the muscular structure will be seen to be dense and firm, and little or no fat will be present. If there is much fat, and the wall is soft, the number of sacculi will be very numerous, and the more fat there is the smaller will be their orifices of communication and the larger will be the cavities. The following cases I will give in detail, as they display well many of the points mentioned.

T. H—, æt. 51, a large, fat man, was admitted into Guy's Hospital, under Mr. Davies-Colley, on September 1st, 1884; he died very suddenly on September 4th. He had had an inguinal hernia as long as he could remember, and within the last few years it had become irreducible. When a boy he received a severe blow in the perineum while sliding down a ladder. He had experienced great difficulty in passing his water since that time. Twenty years ago he had an attack of retention, and Mr. Bryant performed perineal section, and he left the hospital cured. Soon after this he noticed that urine escaped from the perineum. This soon ceased. Four or five years ago an abscess formed in the same region, and after it had burst urine continued to escape through the fistulæ which remained. When admitted into the hospital he was passing all his urine through the perineum.

At the post-mortem examination I found the heart uniformly hypertrophied and weighing 22½ oz.. There was no fibroid or fatty change perceptible to the naked eye, but there was a great deal of fat deposited around the heart, and extending for some way into the walls. The margins of the mitral valves were slightly thickened, but the other valves were healthy.

The œsophagus presented some slight superficial scarring of the mucous membrane of the lower part, but it did not apparently interfere with its calibre. About the centre of the œsophagus was a depression in its walls on its inner aspect as large as a threepenny piece, and crossing it vertically was a bridle of mucous membrane, between which and the floor of the cavity a large probe could be passed. On the same level and on the opposite side of the œsophagus was a vertically oval foramen, a third of an inch long. This opened into a cavity which was three quarters of an inch in length and vertically oval. It was lined by mucous membrane. This diverticulum of the mucous membrane was situated in the muscle wall of the œsophagus, but unless distended it did not produce any prominence externally.

The two depressions being on opposing aspects of the mucous membrane would suggest the idea that they were due to a common cause, possibly ulceration following the irritation of a foreign body. The fact that the mucous membrane lining either depression moved freely on the subjacent wall may militate against this hypothesis, but to what extent I do not know.

On opening the sac of the large acquired inguinal hernia on the left side, a piece of omentum was found attached to its lowest point. Its upper extremity was free and presented a cicatricial contraction. Lying in the neck of the sac and adherent to it was the end of a piece of omentum which presented a cicatrix corresponding to that on the lower piece.

Occupying the sac was a single loop of large intestine, which with its mesentery was loaded with fat. It was adherent near its neck and posteriorly. The loop of gut measured nearly a foot in length. On laying it open that end which was upon the abdominal side of the internal ring was seen to be much dilated, while the proximal end of the loop was very narrow and presented a double row of sacculi separated by a prominent ridge formed by the band of longitudinal muscle-fibre. Fig. 2 shows the loop laid open and the gut continuous with either end of the loop. Also the lower row of diverticula, from which the appendices epiploicæ have been removed. Though the diverticula were placed in the appendices epiploicæ their position there was apparently accidental, for the reason that the diverticula, like

the appendices, were only seated in the intervals between the longitudinal bands. At the bottom of most of these depressions were small single circular openings leading into dilated processes of the mucous membrane covered by a thin layer of the muscle coat. In many of these sacculi this muscular covering appeared to be absent; in character they resembled the diverticula seen in the bladder. The distal half of the loop increased gradually in calibre, losing its sacculated appearance, the prominent ridge of longitudinal fibres becoming indistinct, and then disappearing in the distal extremity of the loop, which was very much dilated.

Fig. 2.



The piece of gut continuous with this in the abdomen opened into the dilated end by a very small constricted orifice, resembling in appearance the œsophageal opening into the stomach. This part of the intestine was contracted and was not unlike the œsophagus, its walls being thick, its calibre small, and its mucous membrane arranged in close longitudinal folds. The contraction of the proximal half of the loop in a transverse and longitudinal direction had resulted in the production of the prominent longitudinal ridges and the formation of the saccu-

lated appearance. The diverticula of the mucous membrane were evidently produced in the same way as were the corresponding diverticula in the bladder, namely, by the vigorous contraction of this portion of the loop on its contents, forcing them into the distal half, which on that account became enormously dilated. The very small size of the orifice of communication with the gut in the abdomen and its position formed a considerable and a progressively increasing obstacle to the passage of fæces into it.

The kidneys were apparently healthy. The papillæ were not flattened, neither were the ureters or pelves dilated. The wall of the ureters in the lower half of their extent was thicker than usual.

The bladder was small. The wall was thick, but there was a great deal of fat in it, which rendered the tissue soft. Its inner aspect was not fasciculated. The mucous membrane lining the whole of that surface of the bladder which is covered by peritoneum was peculiar in that it presented a very large number of diverticula, which varied in size from minute depressions in the mucous membrane to a sacculus as large as a walnut. This large sacculus had a small orifice of communication which was situated an inch above and a little external to the orifice of the left ureter.[1] Its wall contained a good deal of muscle-fibre and fat. At the upper angle of the bladder and apparently at the point of attachment of the urachus was a diverticulum of mucous membrane *which had no covering of the muscle wall.* It was as large as a small marble, with a small orifice of communication with the bladder cavity. This resembled exactly several others I have seen in this position. Many of the other diverticula were simply processes of mucous membrane which projected for a variable distance into or through the wall of the bladder and terminated in the fat. In others there was a distinct coat of muscle-fibre. The fat which was so abundantly present seemed to favour the formation of these herniæ of the mucous membrane and to determine their development.

The prostate was small and tough. In the prostatic sinuses were openings leading into small branched cavities in the lower

[1] It will be noticed that in three of the cases described, the largest sacculus present opened into the bladder at this point.

part of that gland. The walls of the vesiculæ seminales and vasa deferentia were thick. The tissues about the prostate were very dense. The membranous urethra was much constricted, and terminated by a pointed extremity in the indurated connective tissue which surrounded it; opening into it were numerous sinuses, six of which terminated in the perineum near one another, while four or five ramified in the dense cicatricial tissue, and one terminated in a slightly dilated extremity, while the others ended abruptly.

The proximal end of the penile urethra was about half to three quarters of an inch distant from the termination of the membranous urethra, the intervening portion of the urethra having been apparently obliterated for some considerable time. The whole of the penile urethra was very narrow and inelastic; and the posterior inch of its length was filled up by irregular longitudinal folds of cicatricial tissue.

The next case is interesting from the large number of sacculi present in the bladder wall. In this case there was no complaint or mention made of any trouble in connection with micturition. The stricture affected the posterior inch of the bulbous urethra. The wall of the membranous urethra appeared to be thicker than usual, but the calibre of this tube was not visibly increased in size.

The middle lobe of the prostate was hypertrophied and produced a considerable eminence, which projected into the neck of the bladder. The wall of the bladder was very thick, but its outer portion was soft owing to the *large amount of fat* which covered its outer surface, and which was developed between the bundles of muscle-fibres. There were a very great number of diverticula of the mucous membrane of that portion of the bladder wall which is covered by peritoneum, three of them being about as large as a walnut, and the others being smaller. They had all a covering of muscular tissue, and were remarkable in the smallness of their orifices of communication, so much so that unless they were very carefully looked for they would have escaped observation. In one of the sacculi was a smooth rounded stone as large as a pea, and in many of the smaller ones were minute stones. Many of the diverticula had small secondary diverticula in their walls. The two largest diverticula, which were situated very low down,

formed only one prominence when distended on the outer aspect of the bladder, and they possessed a separate as well as a common covering of muscle-fibre.

FLEXIONS OF THE FINGERS—DUPUYTREN'S, &c.

AND SOME SENILE CHANGES IN JOINTS.

By W. ARBUTHNOT LANE, M.S.

As there has been recently much discussion as to the best form of treatment of the condition which is called Dupuytren's contraction of the hand, and as various writers on the subject have each asserted that one particular form of treatment is better than another, and have enumerated cases successfully treated in support of their different views, I have for some time been on the look out for an example of this deformity in the dead subject, and was at last fortunate in finding two well-marked instances. I made a very careful dissection of the right hand, and from the description of it one can easily see how it is that in many instances of the disease these various treatments may be equally successful in producing a satisfactory result, whether multiple or single incisions be used or complete excision of the indurated portion of tissue, and how in other cases one of these forms of treatment will succeed when the others will fail.

The two inner fingers of the right hand of a male subject were semiflexed on the palm, the ring finger being somewhat more so than the little finger.

On extending them a prominent band appeared, running from the outer aspect of the first phalanx of the little finger

along the palm to the annular ligament. The phalanges of this finger were but slightly flexed on one another.

In the case of the ring finger, a firm band was seen to bridge across the angle between the first and second phalanges, running from about the base of the first nearly to the head of the second. No ridge appeared in the palm, but the web between the fourth and fifth digits became hard and prominent on extension.

On removing the skin, it was found to be very thin over the fibrous band connecting the phalanges of the ring finger, and to be very intimately united with it so as to require careful dissection to remove it without button-holing it. The subcutaneous tissue was also dense over the band going to the little finger, but there was not the same intimate union with the skin.

On tracing out the digital nerves of the ring finger they became very ill-defined in the dense fibrous tissue, from which they were dissected with the greatest difficulty. Beyond this point the nerves regained their usual appearance. It was impossible to divide into fasciculi that portion of the nerve which was so intimately blended with the surrounding fibrous tissue.

On removing this dense subcutaneous tissue there was seen some thickening of the superficial transverse ligament connecting the process of palmar fascia running to the ring finger with that going to the little finger, and this extended into the lowest limit of the web. On removing this, the vaginal sheath over the first and second phalanges of the ring finger was seen to have undergone a curious transformation.

Stretching from the fibrous sheath covering the first phalanx to that covering the second was a dense fibrous bridle, continuous along the whole of its convexity with the thickened vaginal sheath, and presenting a free, straight margin, which was before seen to have been intimately blended with the skin. The depth of this band was about one third of an inch. It had no connection with any process of the palmar fascia, nor with any other structure but the vaginal sheath, from which it had evidently arisen.

It prevented extension of the articulation, but did not interfere with flexion. The tendons of the flexor muscles passed through the sheath without presenting any modification.

They had become tight owing to the continual contraction of the part of the flexor muscles with which they were connected, and so opposed extension. On dividing the fibrous band with the vaginal sheaths and the tendons, although I used considerable force, I was not able to extend the joint. This movement was opposed by the contracted and thickened anterior ligament of the joint. On dividing this, and again applying extension, the finger flew into a position of over-extension, and would no longer occupy its normal position or any one intermediate between the one it first occupied and that of over-extension.

This was seen to be due to the fact that the lateral ligaments had undergone contraction owing to the prolonged flexed position of the articulation, so that they were made very tight when the finger was straightened. On opening the joint the cartilage over a portion of the anterior surface of the head of the bone was smooth, white, and opaque in appearance; elsewhere it was superficially eroded, transparent, and gelatinous, and the synovial membrane encroached on the cartilaginous margin. On the upper surface of the base of the second phalanx the portion of the cartilaginous surface which had articulated with the anterior surface of the head of the first phalanx retained its normal appearance, while elsewhere it was modified as described above. The articulation between the second and third phalanges was quite normal.

The vaginal sheath of the little finger was quite normal. That process of the palmar fascia which went to the little finger, and more particularly that division of it going to the outer margin of the first phalanx, was thickened. It was intimately united with the subcutaneous tissue covering it which had become dense and fibrous. On dividing it the finger was easily straightened.

Where the digital nerve crossed this band there was a similar though less marked intimate connection between it and the surrounding dense fibrous tissue. As the body had been in the dissecting room for some time I did not attempt to examine the nerves microscopically, though I think it probable that they would have presented some deviation from the normal. The left hand presented similar changes, so I will not give a detailed description of it, beyond that the middle finger was most flexed,

and that the main body of the palmar fascia was only slightly affected, but that the vaginal sheaths were much thickened together with the anterior ligaments of the articulations. The superficial transverse ligament of the fingers was very thick and dense and was closely blended with the thickened vaginal sheaths. The anterior ligaments in these fingers where shortened as the result of the prolonged flexion of the fingers offered great opposition to their extension.

This dissection shows sufficiently well that the treatment required depends very much on what structure is contracted, and that one cannot lay down any hard and fast rule, but must be guided by the peculiarities presented by any particular case.

I would now contrast with Dupuytren's contraction another condition of flexion of the fingers which at first sight resembles it somewhat. It is one of flexion of the ring and little fingers, sometimes of all the fingers, in old people, who are usually if not always affected by rheumatism or rheumatoid arthritis. I found in the dissecting room a female subject whose two inner fingers of both hands presented this deformity in a marked degree. The metacarpo-phalangeal articulations were slightly flexed; those between the first and second phalanges considerably so. The first resisted flexion, though they yielded a little under pressure, while the latter were almost fixed, allowing of only a very slight flexion movement. The heads of the first phalanges were very prominent, and projected beyond the bases of the second.

On removing the skin the palmar fascia was found to be perfectly healthy. The vaginal sheaths were not thickened, though they had accommodated themselves to the position of continual flexion. The tendons presented no adhesions, nor was their synovial covering thickened. On clearing away these structures from the articulation between the first and second phalanges, the anterior ligaments, like the lateral, had accommodated themselves to the changed position of the parts. The base of the second phalanx did not rest as in normal flexion well upon the anterior surface of the head of the first phalanx, but was displaced a little upwards, so that only the posterior portion of its base rested upon it.

The ligaments surrounding the joint were not thickened. The lateral ligaments had lost their defined outline, and

formed merely a portion of a fibrous capsule. The synovial lining was thickened and encroached on the articular surfaces. The base of the second phalanx presented in the general articular surface a transverse depression at its back part. This was the part of the base which alone articulated with the head of the first phalanx; the remainder of the base rested on its shaft. The cartilage covering the heads of the first phalanges presented a smooth healthy appearance, except on its upper and anterior part, where there were depressions in the cartilage in that portion which alone articulated with the second phalanx. In some instances of this condition I have found these phalanges united at points by fibrous tissue, the opposing surfaces of cartilage appearing to undergo change into fibrous tissue producing a true fibrous ankylosis of the joint.

This deformity of the fingers, amounting in some cases to a partial upward dislocation of some of these joints is, I believe, the result of their continual flexion.

In old people the metacarpo-phalangeal and interphalangeal articulations, like many of the other joints, are rarely extended, but are kept in a more or less flexed position. This condition of flexion becomes more marked as time goes on; particularly so if the patient is affected by rheumatism or rheumatoid arthritis.

As examples of this acquired flexion of joints with modifications of the form and character of the parts entering into their formation, I would point to the extreme dorsal excurvation producing well-marked pressure changes in the vertebræ and intervertebral substances so often seen in old people and associated with compensatory changes in the rest of the spinal column. I have referred to them at length elsewhere ("Changes in Spinal Column produced by Pressure," 'Path. Soc. Trans.,' 1885; "Three Forms of Spinal Deformity," 'Med.-Chir. Trans.,' 1884, &c.).

I would also direct attention to the elbow-joints in old people which sometimes cannot be completely extended owing to deposit partly on the floor of the olecranon fossa, and partly on the margin of the olecranon process itself. In some cases a thickening of the plate of bone between the coronoid and olecranon fossæ is all that can be made out. In a paper in the 'Transactions of the Pathological Society,' 1884 ("Partial

Mollities, Rheumatoid Arthritis, and Charcot's Disease") I described a well-marked instance of this condition which was perfectly symmetrical. The wrist-joint is sometimes, though more rarely, definitely altered in form. The direction of the lower articular surface of the radius and interarticular fibro-cartilage from being almost transverse alters to one which looks from above downwards and inwards. This is, I think, due to the forearm being retained in a semi-pronated position and the hand somewhat adducted. This condition was very well marked and was also symmetrical in the case I have just referred to, though I did not describe it in that paper, as it did not bear in any way upon the question discussed in it.

In old, feeble people, the hip-joint also undergoes very considerable alteration. Owing to their peculiar gait produced by the condition of continual flexion, the head of the femur becomes changed in form. Its articular surface becomes more extensive, encroaching considerably on the neck anteriorly. As a result of this the head becomes much more globular in form. The acetabular cavity shows corresponding compensatory changes. I find this change very much more common than that alteration in the direction of the neck of the femur so often referred to by surgical writers as occurring in old people. If one were to judge of its frequency from the examination of the aged subjects in the dissecting room, one would perhaps be inclined to consider the latter change a very rare condition, but the number of authors who have described it make one hesitate to pronounce too decidedly a contrary opinion. At the same time one cannot but be struck by the way in which one author copies the assertions of another without attempting to verify them, and a later one follows again in his footsteps; many errors are perpetuated in this manner.

As another instance of the modification a joint undergoes I would point to the temporo-maxillary articulation. Everyone is familiar with its normal condition in active adult life. When the jaws become edentulous, and the teeth are not replaced by artificial ones, the normal movements of the jaw are limited to the simple forward and backward movement by which these old people triturate their food. As a result of this changes take place in the fibro-cartilage by which it becomes

much thinned in its centre and then perforated, and often in great part removed. Later the bony portions of the joint change their form. The condyle of the jaw becomes flattened on its upper surface, while the concavity of the glenoid cavity is apparently diminished by the gradual destruction of the eminentia articularis. These changes are much modified by the presence of rheumatoid arthritis. If, as is usual, the joint is attacked before the teeth drop out and while the bones are still dense, you get an increase in breadth of the upper surface of the condyle by marginal deposit, destruction of the fibro-cartilage, grating, &c., but in a subject whose osseous system is very feeble, and whose jaws are more or less edentulous, you get rapid destruction of the condyle of the jaw, eminentia articularis, and fibro-cartilage, producing what is called Charcot's disease. This is seen to be an exaggeration of the normal senile changes. I described a good example of it in the 'Transactions of the Pathological Society,' 1884, "Rheumatoid Arthritis, &c.," where the subject is more fully discussed.

Another condition I would call attention to is the change so frequently seen in the shoulder-joints of old people, which is usually ascribed solely to the fact that the articulation is affected by rheumatoid arthritis. This change is present in a marked character in the bodies of feeble, old, decrepid people, and is usually much more advanced on the right side than on the left. In the normal healthy joint of active adult life, when the arm is used freely and not limited to any particular movement, the head of the bone is seen to present a well-defined margin, the tuberosities are prominent and distinct, and the insertion of the scapular muscles into them can be easily seen. The changes seen in the joint affected by rheumatoid arthritis are very familiar to everyone. The head of the bone grows in surface area as it approaches the tuberosities, and sometimes encroaches on them. These are flattened and often indistinct, the insertion of the muscles into them is no longer present except at their outer limits, and then the tendons of these muscles are usually wasted and lost in the fibrous capsule of the joint. The capsule in its upper part is often very much thinned by pressure or has acquired new attachments. The tendon of the biceps has been destroyed by the same upward pressure and has acquired an attachment to the bicipital groove.

The glenoid cavity is enlarged above, its cartilage frequently presenting changes.

The acromion and outer end of the clavicle are grooved by the pressure of the head, and the joint between these bones opened. The synovial lining of the capsule may or may not present abundance of those branched pedunculated processes of synovial membrane which are more often seen in this joint than in others. Now, the question arises as to how far these changes are the result of the rheumatoid irritant, and how far the result of pressure applied in a particular direction to a joint the movements of which have become very limited owing partly to the diminution in the freedom of movement of a joint affected by rheumatoid arthritis, and partly to the limited movements of feeble old age. This application of pressure in an upward direction is produced in part by the action of muscles and in part by the person leaning for support upon one or two sticks; the direction of pressure is in either case directly upwards. This pressure, I believe, is the active cause of the deformity. The only part the irritant of the disease takes in the process of displacement of the head and the formation of a joint differing altogether in character and use from that of active life, is that of exaggerating[1] the slight upward displacement of the head of the humerus seen not infrequently in feeble old age, and so producing the condition just described. I have referred to this elsewhere ('Trans. Path. Soc.,' 1884, "Fracture of Acromion"). I have had several opportunities of examining feet in the dissecting room in which the base of the first phalanx has been displaced outwards so as to articulate with the outer aspect of the head of the first metatarsal bone. In three cases, both these bones had, together with the sesamoid bones, undergone many and striking modifications, owing to the changed form of new articulation. In all the cases I have examined there were marked rheumatoid changes in the joint, yet one would not hesitate to ascribe the outward displacement of the phalanx and the accompanying modifications of the ligaments and bones to pressure alone. The presence of rheumatoid arthritis in these cases in this articulation was only an accidental circumstance and did not stand to the displace-

[1] "Pressure Changes in Lower Part of Spinal Column," 'Trans. Path. Soc.,' 1885.

ment in the relation of cause and effect. It is so very exceptional to find a subject in the dissecting room quite free from this disease, that one need not be surprised at its frequent presence in these cases. The great difficulty which arises in a joint affected by rheumatoid arthritis is to decide which are the changes produced by the presence of the irritant alone and which are produced by the continual application of pressure in one direction in a joint the movements of which are modified and limited by the presence of rheumatism or rheumatoid arthritis.

We may conclude from these changes that we can by pressure alone produce very considerable changes in a joint, altering not only the ligaments but the form and aspect of the bones entering into its formation.

For further details on several of these changes, I would refer the reader to a paper in the 'Transactions of the Pathological Society,' 1886, "Pressure Changes in the Joints of the Extremities."

ABNORMALITIES

OBSERVED IN THE

DISSECTING ROOM OF GUY'S HOSPITAL DURING 1883-84.

By W. HALE WHITE, M.D., W. ARBUTHNOT LANE, M.S.,
AND
J. A. P. PRICE, M.B.

Bones.

We have so frequently observed a ligamentous band separating the divisions of the inferior maxillary nerve that it might almost be considered normal. As an example of it we may mention the following exaggerated instances which occurred in a male subject. On the left side of the body there was a spicule of bone projecting back from the external pterygoid plate, and a similar one projecting forwards and downwards from the spine of the sphenoid. They did not quite touch each other, but the very narrow interval was filled up by dense ligamentous tissue. These bony spicules served to separate the inferior dental from the lingual gustatory which lay internal to it.

Muscles.

Head and neck.—One example of the levator of the thyroid body was noticed. It was bilateral and symmetrical, a fleshy slip a third of an inch wide, descending on either side of the

middle line to be inserted into the isthmus of the thyroid body.

In one subject a small tendon was noticed arising from the tip of the styloid process by a narrow origin, and forming a broad muscular belly which was inserted into the under and outer surface of the cartilage of the external meatus. This slip was bilateral, but better marked on the left than on the right side of the body.

A somewhat similar muscle was observed in a case in which two small symmetrical muscular slips arising from the lower part of the cartilage of the meatus auditorius externus passed downwards and forwards, forming narrow tendons, which were inserted partly into the outer surface of the styloid process, and partly formed a portion of the stylo-hyoid muscle.

In another subject a small supernumerary slip of muscle, a quarter of an inch wide, extended from the outer part of the orbicularis palpebrarum and passed downwards and inwards and blended with the levator labii superioris near its insertion. It existed on the left side only.

It would appear that this is an enlargement of a normal or almost normal slip figured by Henle in plate lxxvi of his 'Atlas.'

In a male body there was seen a tendinous slip arising from the lateral mass of the atlas, and from the fascia over the rectus capitis anticus major, and below after touching the posterior margin of the sterno-mastoid it was inserted by fleshy fibres into the clavicle outside that muscle. We can find no reference to any similar slip in any of the standard works on anatomy.

As in former winters many examples and variations of the rectus sternalis brutorum came under our notice.

Upper extremity.—Several abnormalities in connection with the biceps humeri occurred. One of these was that of a muscular slip which arose from the humerus and adjacent deltoid tendon, just to the inner side of that muscle. It was about a third of an inch wide and was inserted into the outer side of the biceps tendon, immediately above each elbow. This abnormal muscle had no tendon.

We met with one example of a five-headed biceps (Fig. 1). Of the extra heads, the largest (5) was three quarters of an inch wide, and fleshy throughout. It arose from the humerus just below

the insertion of the coraco-brachialis and was inserted into the inner margin of the biceps tendon immediately above its termination. The fourth head (3), the next in size, arose at the lower part of the bicipital groove and was inserted into the angle of junction of the short and long heads of the biceps. It was fleshy throughout the whole of its extent. The fifth and shortest head (4), also entirely fleshy, arose from the humerus between the two pointed origins of the brachialis anticus, and was inserted close to and on the inner side of the insertion of the fourth head. This slip was half an inch wide.

Fig 1.

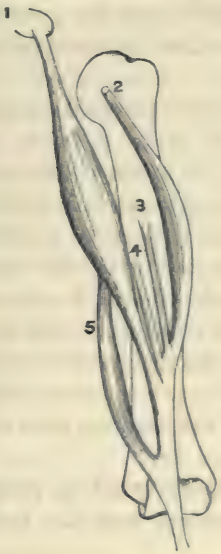
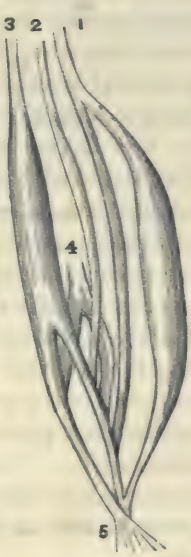


Fig 2.



In another subject we observed a biceps consisting of several distinct bellies, and having five heads of origin, two of which bifurcated before their insertion. That portion of the muscle (3 in Fig. 2) which arose from the coracoid process at the junction of its middle with its lower third divided into two fleshy bellies which soon becoming tendinous, united just before the tubercle of the radius was reached. An abnormal fleshy head (4) arose from the humerus just above the origin of the brachialis anticus and quickly divided into two pieces, which were

respectively inserted into the lower part of the two fleshy bellies into which the coracoid portion of the muscle divided. A third abnormal head (2) arose by a narrow tendon from the lesser tuberosity just inside the bicipital groove. It soon became fleshy and was inserted into the lower part of the outer of the two divisions of the coracoid portion of the muscle. The last abnormal portion of the muscle (1)[1] arose from the bicipital groove by a tendinous portion. It soon became a narrow fleshy band, and was inserted close to the insertion of the portion last described. The long head of the biceps was normal but formed a separate belly of considerable size.

Several cases of abnormalities in connection with the pectorals were observed. In one of them the pectoralis minor arose from only two ribs. In another the same muscle had the following abnormal insertion:

Its tendon was unattached to the coracoid process, passing over it, but was bound down to it by a dense ligamentous sheath. It then passed beneath the tendons of the supra and infraspinatus muscles, being closely connected with the capsule of the shoulder-joint, and being covered on its under surface by synovial membrane. It was inserted into the centre of the upper part of the facet for the teres minor. On its way over the joint there arose from its outer margin a dense prolongation strengthening the capsule. On the right side of the same subject the inner part of the pectoralis minor took a similar course, while the outer part presented the normal insertion into the coracoid process.

Once the pectoralis minor was observed to pass under the coracoid process and to be inserted into the tendon of the supraspinatus.

In the forearm a distinct muscle was in one case seen arising below the extensor indicis, and passing through the annular ligament with the extensor communis and indicis. It was inserted into the expansion of the extensor communis on the second finger.

On the left side of the first subject recorded as having a five-headed biceps, the lower part of the muscular belly of the

[1] In the woodcut this head has been drawn incorrectly, as though it arose in common with the long head of the biceps, which lay upon and concealed its origin.

flexor longus pollicis in the forearm gave origin on its inner side to a small rounded muscle which soon terminated in a tendon which was inserted into the outer side of the first lumbrical muscle.

Lower extremity.—On the left side of one subject a tendinous origin of the vastus externus was continued up from the great trochanter to the anterior inferior spine, so lying parallel with the anterior edge of the gluteus minimus.

Once we observed that the flexor brevis digitorum did not send any slip to the little toe, but the flexor longus digitorum sent two slips to it, the abnormal slip going to the inner side of the base of the first phalanx of the little toe.

In the above subject the lumbricales were all absent, and the second and fourth toes each received a slip of tendon exactly similar to that described in connection with the fifth toe, being thus inserted into the inner side of the base of the first phalanx.

On the front of the leg the peroneus tertius was inserted into the bases of both the fourth and fifth metatarsal bones.

In one body a muscular slip arose by an aponeurosis from the femur at the lower extremity of the femoral head of the biceps, and joined the inner head of the gastrocnemius on its posterior surface just above the junction of the two bellies. This abnormal slip passed between the popliteal vein and internal popliteal nerve.

Vessels.—In a subject in which the left vertebral artery came from the arch of the aorta and went through the foramen in the transverse process of the fifth cervical vertebra, the profunda cervicis artery on the same side was a branch of the first part of the subclavian.

On the right side the vertebral artery was much enlarged, and normal in origin and distribution.

An instance of a not very uncommon abnormality in the number of the branches of the arch of the aorta presented itself. About a third of the way up the innominate, the left carotid was given off and passed diagonally upwards and to the left behind the left innominate vein and in front of the trachea to the left sterno-clavicular articulation, whence it assumed a normal course. The left carotid, whilst it was passing under the left innominate vein, gave off the left pericardiac artery, and

the right pericardiac artery came from the innominate. The left bronchial came off from the left carotid.

We have seen several well-marked instances of a condition of the internal carotid which is described by Ellis. It consists in the vessel making a bend like the letter S opposite the atlas or axis. This appears to be certainly anatomical and not pathological, as the other vessels in the body were in no wise tortuous.

A remarkable abnormality in the arteries of the base of the brain was seen, in which the internal carotid on the right side, whilst in the cavernous sinus, gave off at its posterior part a branch as large as the vertebral. This immediately pierced the dura mater, and passed straight back to terminate in the basilar just in front of the point of junction of the two vertebrals.

A few instances of abnormal origin of the suprascapular artery were observed. In two of these it arose from the third part of the subclavian, and in one from the first part of the axillary.

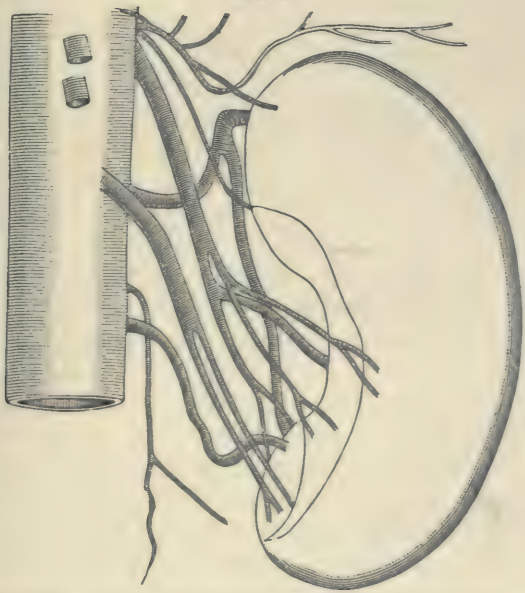
Amongst numerous examples of abnormalities in the origin and course of the radial and ulnar arteries, we would specially notice the condition of vessels in which they were remarkably abnormal on both sides. On the left side the ulnar artery arose from the third part of the axillary, and having perforated the deep fascia in the middle of the upper arm, became superficial. It then again perforated the deep fascia at the junction of the upper and middle third of the forearm; subsequently its distribution was normal. The trunk representing the brachial bifurcated at the usual point of division into radial and interosseous trunks, the latter giving off the anterior and posterior ulnar recurrents. On the right side the brachial gave off the superior and inferior profunda, and divided in the centre of the upper arm into a common interosseous trunk, and a branch which occupied the normal position of the brachial; this gave off the anastomotica magna, and divided just above the level of the internal condyle into radial and ulnar; the ulnar lay above the muscles and beneath the deep fascia.

In another body the ulnar artery was given off just above the elbow and ran down the forearm superficial to the muscles till it reached its inner border; just above the wrist it passed

superficial to the annular ligament and supplied by large branches the three and a half inner fingers, and terminated in minute branches to the thumb, and to the outer side of the index finger.

A left kidney (Fig. 3) was observed with no fewer than six different renal arteries arising separately from the aorta; there were also two separate renal veins which united to form a short trunk lying on the aorta and opening into the vena cava. The left spermatic artery also sent a separate branch to the lower end

FIG 3.



of the kidney. The ureter did not begin in a pelvis but as two small branches from the upper part of the kidney and two small branches from the lower part; each pair united into a single trunk and the two trunks, thus formed, went to make the ureter.

The spermatic artery was once seen to come from the lower division of the renal on the left side; it accompanied the vein.

UTERINE DILATATION,

WITH ILLUSTRATIVE CASES.

By P. HORROCKS, M.D.

Rigid creeds paralyse progress. To them may be ascribed in many instances the slow advance made not only in the art and science of medicine and surgery, but also in all other arts and sciences.

That the peritoneum can be opened, and operations performed within its cavity, the wound being afterwards sewn up without a fatal result in the majority of instances, would not have been believed by medical men fifty years ago and less, simply because they were under the baneful influence of a rigid creed, which now turns out to be false. They believed that wounding the peritoneum would cause death in the majority of instances. That was false, as is proved now every day in practice. It was not the wounding of the peritoneum which proved fatal, but the admission of septic matter. The latter being eliminated either by antiseptics or by cleanliness death does not follow. Death did follow peritoneal operations formerly, and a false deduction was drawn; the creed based on this paralysed progress.

Lister came and taught the doctrines of antiseptics and cleanliness. Wells, Keith, and others applied them to the peritoneum, and the current belief in regard to the serous

membrane was shown to be false. Look at the marvellous progress made in abdominal surgery since the false rigid creed has been swept away!

It would be easy to multiply examples from the history of medicine and surgery to prove the dictum already laid down. Probably no domain in our profession has been hedged in by so many rigid creeds, false dogmas, and intolerant prejudices as that of gynæcology. Thanks, however, to the liberal spirit of the age, thanks to the toleration of independent opinion and action, and thanks to the indefatigable labours of those who have devoted themselves to the study and development of some single department, the prejudices, dogmas, and creeds have been fought, step by step, some have been vanquished, whilst others are still resisting feebly.

The rigid paralysing creeds being relaxed, progress begins. The results are wonderful, especially to those who, infatuated by their creeds, would not and could not do anything inconsistent with those beliefs.

Dilatation of the uterus for the purpose of diagnosis or treatment would at one time have been scouted as too dangerous to be at all justifiable. Many practitioners even to-day are afraid of such a procedure. I hope to show in this paper that, when conducted by proper methods and under suitable conditions, it is harmless in almost all cases, and is productive of the happiest results.

The subject of contraction and relaxation of muscular fibre has not yet been fully worked out. But it has been shown that it is a rule for the opponents of a muscle to relax, when that muscle itself contracts. For example, the flexors relax when the extensors contract; again, the radiating fibres of the iris (unstriped muscle) relax when the circular fibres contract. Another rule which has been pointed out is that the sphincteric muscular fibres of the orifice of a cavity relax when the fibres in the wall of the cavity contract, *e. g.* the sphincter vesicæ relaxes when the bladder wall contracts. The sphincter ani relaxes in defæcation.

The œsophageal end of the stomach is said to relax in vomiting, *i. e.* when the wall of the stomach is contracting. Similarly the cervix uteri (=sphincter uteri) relaxes when the fundus uteri contracts. These are really further examples

of the law, because the sphincter of an orifice is the opponent of the detrusor of the cavity.

The converse of this rule is also said to hold good, viz. that when the sphincter contracts the wall relaxes. Thus, when the cervix uteri contracts the fundus dilates, and this opposite action of the two poles of the uterus is sometimes spoken of as the law of polarity. Now, if this law be true it is of the first importance to obstetricians. As a rule, however, in diseases of women apart from midwifery, this law is not of such importance, because usually when dilatation is required we wish to expand, not only the cervix, but also the fundus of the uterus. I intend, however, to speak of all forms of dilatation, whether of cervix or fundus, or both.

When one studies nature's method of dilatation we find that it is accomplished by hydrostatic pressure. The fundus uteri is expanded by the hydrostatic pressure of the liquor amnii, which gradually increases in quantity. The force of this is increased by the growth of the fœtus, but it is not the fœtus which presses asunder the uterine parietes, but the liquor amnii, which obeying the law of fluid pressure, exerts an equable force on all parts.

The uterine walls get thinned out as dilatation goes on, but at the same time there is a large increase in the number and size of the muscular fibres. Hence the thickness of the uterine wall is just as great at the full term of gestation before delivery as it is in the unimpregnated condition, whilst just after delivery it is very much thicker.

The uterus is sometimes dilated by a tumour within its cavity, such as a fibroid polypus. But in this case there is a greater degree of hypertrophy of the walls in proportion to the amount of dilatation. This is merely another instance of the general law that obstruction produces hypertrophy.

The polypus is treated by the uterus as a foreign body. It tries to get rid of it. Hence the enlargement due to action. There is one thing, however, which is very striking in connection with every example of nature's methods of dilatation, namely, that the dilatation is *slow*. Now, this seems to me to be a most important point and one worthy of consideration. Much has been written on rapid methods of dilatation, and

when the amount of expansion required is not great, it does not make any difference how fast it is accomplished. But when the os uteri has to be dilated sufficiently for the birth of a child, or when it is desirable to pass a finger into the uterus for examination, I maintain that to rapidly dilate the uterus is a pernicious practice fraught with grave risk to the patient, whilst to do it slowly and intermittently, and at the same time antiseptically, is much more satisfactory in result and almost free from danger.

If it were possible to imitate nature's method exactly by intermittent, slow, equable, hydrostatic pressure that would be undoubtedly the best plan. The water-bag dilators introduced by Barnes for dilating the cervix in labour are based upon scientific principles, and hence their great success. At the same time it must be admitted that the pressure they exert is constant and not intermittent. Hitherto, however, no better artificial method is known. They have been the means of saving numberless lives, for the mortality following the clumsy dilatation and rapid extraction previously in vogue was frightful. And anyone who has had experience in their use will know that the dilatation effected is very much more thorough and satisfactory when there has been sufficient time allowed; in other words, when it has been a *slow* process.

The cavity of the normal non-pregnant uterus, including the cervix, is potential, *i. e.* its walls are in contact but allow of separation. An ordinary uterine sound, whose diameter at the tip equals three sixteenths of an inch, will pass readily up to the top of the fundus of a virgin uterus after puberty.

After childbearing there is as a rule more or less splitting of the cervix, and therefore more or less patency of the os externum and the lower part of the cervical canal, and it is quite easy to introduce bougies as large as a No. 12 gum elastic catheter.

In many cases where dilatation is required there is already a certain amount of expansion and therefore much larger instruments can be introduced. The uterus possesses a considerable amount of elasticity as well as contractility. If dilated forcibly and rapidly its fibres are not simply stretched but ruptured also.

After dilatation it soon attains its previous dimensions by elastic recoil and vital muscular contraction. Remembering then these facts, what are the best methods of dilating the uterus?

They may be divided into six kinds:

1. India-rubber bags capable of distension by fluids or gases.
2. Tents which swell out when in contact with moisture.
3. Graduated bougies.
4. Metallic instruments capable of expansion.
5. The fingers.
6. Incisions.

1. The best known of the india-rubber bags are the fiddle-shaped ones introduced by Barnes for the dilatation of the os and cervix in parturition. They are distended usually by water. On the original pattern is a shoulder into which a blunt instrument like a catheter is passed in order to facilitate introduction. Improvements have since been effected by having a central tube opening below and quite distinct from the water-containing cavity.

Barnes's bags are not easy to introduce in many cases. I not unfrequently find that students are quite unable to introduce them. It requires a little skill and practice. The os and cervical cavity must be considerably dilated before the smallest bag can possibly be introduced.

When a bag is introduced it is distended by injecting water through the tube hanging from the lower end. When sufficiently distended, which can be best ascertained by feeling the lower end of the bag, the tap is closed and the bag left *in sitû* for a certain time. During this time the pressure exerted does not increase, whilst the cervix is gradually yielding, hence the amount of pressure upon the walls of the cavity is constantly diminishing. Moreover, whatever pressure is exerted is in action all the time. So that we have a gradually diminishing force constantly acting instead of what we should aim at obtaining, viz. a gradually increasing force acting intermittently. I have sometimes obtained an intermittent action and eliminated to some degree the diminution of pressure on the receding cervical walls by alternately emptying and filling the bag.

For when the bag is empty there is no pressure, and as the canal expands more fluid can be injected into the bag and so more pressure is exerted on the cervix. I am convinced that in some cases this plan is decidedly advantageous. But the bag itself is not capable of distension beyond a certain point without bursting, hence it must be removed and a larger one substituted.

I find in practice that it takes longer to dilate the cervix with these water dilators than is generally stated in books, and I believe that this is all the better for the patient. It is bad to hurry the procedure; it is worse to deliver before dilatation is complete. And it not unfrequently happens when the artificial dilatation has been rapid that the expansion is not sufficient even after the largest bag has been inserted.

In gynæcological cases Barnes's bags are inadmissible, at all events until a certain amount of dilatation has been effected. But water dilators have been invented for commencing the expansion. They have been called finger dilators sometimes and are distended with water after their introduction. They are used in America by some, but have not got into general use in England.

2. Tents, or substances which expand when in contact with moisture, are made of different materials. The best known are the sponge, laminaria, and tupelo.

The sponge tents are made by compression, the laminaria and tupelo by simply drying; afterwards in each case they are cut to the shape required, and in most cases perforated by a central canal running nearly to the top. This is both to facilitate introduction and expansion.

The stiff, sharp, irregular margins of the minute holes on the surface of sponge tents cut and bury themselves into the mucous membrane of the uterus during the expansion of the tent, and when it is withdrawn it frequently tears away the superficial portion of the mucous membrane. When this is desirable, as in certain diseased conditions of the mucous membrane, sponge tents are of use, but inasmuch as the abrasion opens up an extensive area for septic absorption, I have myself all but abandoned their use in favour of the other kinds of tents, although some think that sponge tents

are preferable on account of the greater degree of softening which they induce in the cervix.

Laminaria tents when expanded have curved longitudinal wrinkles on their surface, but are otherwise smooth, and even the wrinkles, being blunt, do not cut the mucous membrane. They cannot be obtained of any size because the laminaria does not grow much thicker than a goosequill. Hence, although they expand over 100 per cent., the amount of dilatation obtainable by a single tent is not very great. Two or three tents can be inserted side by side and so a greater expansion obtained. Another drawback is that they are very hard, and so cannot be pared by a penknife to any shape which may be required other than that ordinarily manufactured.

The tupelo tent has neither of these disadvantages, for it may be obtained, even in the dry state, up to any size that can possibly be required; the root grows thicker than a man's wrist. Moreover, it is soft and can be cut with a penknife. There are few wrinkles on its surface after expansion. The amount of expansion is 100 per cent. Several small tupelo tents can be used side by side, as in the case of laminaria, if this be preferred or if they can be introduced more easily than one large one. I rarely use anything but tupelo now, and have never had a bad symptom following its employment.

Gentian root has been recommended by Winkel ('Deutsche Klin.,' 1867). I have never tried it, but it has the advantage of being cheap.

Tents made of decalcified ivory have been used, but in addition to their expensiveness they have not much dilating power.

Tents are used mostly in cases where it is desirable to make a digital examination of the interior of the uterus. Polypi, fibroids, retained clots, deciduæ, placentæ, ova, &c., can thus be got at and removed, and applications can be made to the mucous membrane of the uterus. They are also used to straighten a flexion of the uterus. They are used also to commence the dilatation preparatory to further dilatation by Barnes's bags in cases of parturition.

Tents should always be dipped into some antiseptic

immediately before introduction. I generally employ salicylic cream (salicylic acid, carbolic acid and glycerine, two, one, and ten parts respectively). The tip only of a sponge tent should be dipped in oil, or, better, smeared with a little prepared lard, otherwise it rapidly absorbs moisture and softens, rendering its introduction impossible.

3. Graduated bougies may be made of steel, vulcanite, or other material. They are shaped something like an ordinary uterine sound, but the part beyond the elbow is generally made of uniform thickness. Sets varying in number from three to a dozen or more can be obtained from instrument makers. Some are made to correspond in size to the gum elastic male catheter, and are numbered accordingly. Thus No. 10 would be the same size as No. 10 male catheter.

These bougies are used chiefly to relieve mechanical dysmenorrhœa, or to promote the chances of conception. They are sometimes used instead of tents, and this is then spoken of as rapid dilatation. It may be possible to remove small bodies from the uterus, or to make intra-uterine applications, but when a digital exploration is required I do not think anyone will deny that tents are much better, effecting a much more thorough dilatation, and that without nearly so much risk to the patient.

Another method is to pass the bougie into the uterus as far as it will go and then fix it in position in such a way that it will be pressed gently on; for instance, by means of a waistband with perineal elastic bands fixed on to the end of the bougie, as in using the repositor in cases of inversion of the uterus. The constant pressure gradually pushes the bougie into the uterus. It can then be replaced by a larger one. This plan is more annoying to the patient and is often unsuccessful through the point of the instrument tilting a little. When the uterus is already dilated to some extent as in retained placenta, &c., bougies are more successful, but not so good as tents because the dilatation is less equable, and affects only one part of the uterus at a time.

4. Instruments which can be expanded may have two or more blades. The best known are Sims's three-bladed and Priestley's two-bladed dilators. They are both made of steel. The blades in Sims's dilator are expanded by pressing the

handles together; those of Priestley's by means of a screw. They are used chiefly for the relief of dysmenorrhœa and to promote conception. At present they are not used when it is desirable to make a digital exploration of the uterus, because to dilate to the necessary extent would be highly dangerous with such instruments. In the 'Archiv f. Gyn.,' B. V. Ellinger describes a steel instrument for rapid dilatation, with the design of procuring a perfect parallel expansion. But Schroeder ('Ziemssen,' vol. x) says that the branches are so thin that they easily bend.

5. The fingers are useful sometimes when there is already a certain amount of dilatation and it is requisite to increase this to a small extent in order to explore the uterus, remove a piece of retained membrane, placenta or clot, small polypus, &c. At the same time it must be done very cautiously, very gradually, and great care must be taken not to lacerate the parts, which is very easily done, especially in the post-partum condition.

6. Incisions by means of metrotomes are often employed to relieve dysmenorrhœa, but in place of the two lateral incisions formerly in vogue, a single posterior slit is now mostly adopted. Incisions are also made in the cervix sometimes to permit of the passage of the child's head or a large polypus.

The following cases illustrate the use of most of the methods enumerated:

Case 1. *Puerperal septicæmia due to a decomposing mass in the uterus.*—In December, 1883, I was asked by Dr. Nichols to see a case with him in consultation.

The patient was thirty-eight years of age, and the mother of eight children, the last of them having been born in July, 1883. This child died when four or five weeks old, and she became pregnant again soon afterwards, but aborted at the third or fourth month. This was a few days ago.

Everything had apparently come away and it was not suspected that anything remained behind, but she became feverish and ill. On my arrival I found her in a low condition, with a dry brown tongue, sordes on the lips, an expression of pain, dry pale skin, abdomen very tender but not tumid,

hard swelling in uterine region, which, however, did not permit of much manipulation on account of the pain. Pulse 160; and feeble, temp. 100°. On vaginal examination the cervical canal was sufficiently dilated to admit the forefinger through the os externum. By careful pressure and rotation sufficient dilatation was obtained to explore the uterine cavity.

I felt something like clot and removed it with my finger. It was not adherent anywhere and easily came away. It was a ragged piece of flesh-like substance about the size of a five-shilling piece. It was black in colour with lighter parts here and there. My impression was that it was chiefly clotted blood; possibly there was some placental tissue as well. At all events its stench was so horrible that I put it into water and ordered it to be removed and destroyed at once. I then felt for more, but could only find small broken-off bits. The uterus was fixed by peri-uterine inflammation, and of course the manipulation necessary gave rise to pain. But without hesitation I passed a tube into the uterus and washed it out with two quarts of hot water, until the returning fluid was odourless. Liq. Opii Sed. ɱxx, Quiniæ Disulph. gr. ij, were ordered 4tis horis. Hot fomentations with turpentine over the lower part of the abdomen. Brandy, beef tea, chicken broth and milk frequently.

Next day, December 25th, I saw her again. Temp. 100·8°, pulse 140. Tongue still dry and brown, but lips a little cleaner. Seems to be in a good deal of pain, but takes more notice of things. On vaginal examination I could find nothing more in the uterus, but the stench on the examining finger was just as bad as before. I therefore washed out the uterus and vagina with two quarts of carbolic lotion (1 in 40). This to be repeated once or twice during the day. I had the whole of the bed-things removed and fresh ones put in their place, and to this I believe she owes in great measure her recovery, for they were saturated with blood, urine, and fæces.

December 26th.—Lips cleaner, tongue still dry and brown. Temp. 99·7°, pulse 128. Has had a good night, bowels not opened for last three days. On vaginal examination, not very offensive odour on finger. Uterus less tender, and more mobile. Syringed the uterus out again. Medicine

repeated; port wine ℥j 2dis horis, brandy ℥j 2dis horis alternately. Enema saponis statim.

27th.—Worse; temp. 100·2°, pulse 160, resp. 28. Tongue dry and brown, slight crepitation and dulness at base of left lung. No cough nor sputa, but I feared pneumonia was beginning. Loud systolic bruit heard all over cardiac region, from which I concluded she had endocarditis, as she had no bruit before. Ordered Tinct. Digitalis ♏v to be added to the medicine. To support her strength, avoid chills, but have plenty of fresh air, and to be syringed out daily.

28th.—She began to spit up rusty sputa. Is very low and weak. Keeps fainting away. Dark rings round eyes, which are sunken. Pulse rapid and intermittent. Ordered Ammon. Carb. gr. v in the medicine.

29th.—Respiration only 24, but she is still in a precarious condition. There is distinct evidence of pneumonia in the left lung, and she is still spitting rusty sputa.

January 2nd.—Patient is a little better. Medicine makes her sick; the digitalis and ammonia omitted.

14th.—From the last date she has been gradually emerging from the rather desperate condition in which she was. Uterus is freely moveable, cervix split, but canal closed.

From this time she steadily progressed, and is now, Dr. Nichols tells me, as well as ever she was.

Case 2. *Flooding from a small piece of retained placenta.*—In August, 1883, during the absence of Dr. Herman, I was called in consultation by Dr. Vance, of North Woolwich, to see a lady under his care who was losing blood. She was a multipara and had had a miscarriage at the third month, two weeks previously; everything was supposed to have come away. I found the uterus freely moveable, os a little patulous, scarcely any uterine lengthening, but it was a little thicker and broader than in the normal condition. The sound passed the usual length with the concavity forwards. As there was not much loss I swabbed the uterine cavity with some Liq. Ferri Perchlor. (B.P.).

She went on well for a fortnight, when a sudden flooding

came on. When I got down the vagina was well plugged and patient was blanched. I removed the plug and introduced a large seatangle tent, which went in easily ; a tampon below this kept it in position. Next day I removed tampon and tent, and without using an anæsthetic passed my forefinger into the uterine cavity, feeling all over its surface up to the roof of the fundus. On the anterior wall I found a small piece of placenta intimately attached. It cost me some pains to remove it, although it was scarcely an inch long and about three quarters of an inch broad. There was no offensive odour about it showing that it had had vascular connection with the uterine parietes. The interior of the uterus felt quite smooth everywhere, except over the site of the removed piece of placenta. I swabbed the uterus with Liq. Ferri Perchlor. (B.P.) and put a tampon in the vagina. This was removed next day and the vagina syringed out with Condy's fluid. She lost no more blood, but was so exhausted by the amount she had lost that it was five weeks before she could get out of bed. Two weeks after this an ordinary menstrual period came on which lasted longer than usual. A month later she menstruated again, this time quite normally. Dr. Vance then sent her up to see me because she had some bearing-down pains, and I did not recognise her—she had so much colour in her cheeks.

These two cases illustrate very well the two dangers arising from retention of pieces of tissue in the uterine cavity. Hæmorrhage and septicæmia are the two things to dread. It is nearly always one or the other, and seldom both, though this may occur. The reason is not far to seek. If the retained piece have vascular union with the uterine parietes, its own nutrition is supported, its vitality is not destroyed, and hence it does not decompose and poison the system with septic material. But bleeding is very likely to occur from its rugged surface and raw edges, the vessels in which are in actual communication with those connecting the piece with the uterus. It may be that sometimes there is a partial rupture of some of the vessels in the adhesions. The hæmorrhage may come on shortly after the accoucheur has left or a long time after the puerperal condition has

been recovered from. The longest time such a piece has remained behind to my own knowledge is two years, and this occurred in a patient in Mary Ward under the care of my colleague, Dr. Frederick Taylor. She was admitted for heart disease, but began losing blood from the uterus. I saw her with Dr. Taylor and removed a piece of undoubted placenta which was adherent to the walls of the cavity of the uterus near the top of the fundus. Her last child was two years of age, and she had never been pregnant since. The piece removed was rather offensive, but she made an uninterrupted recovery so far as the uterus was concerned. Fortunately, when anything is left behind in the uterus the cavities of both fundus and cervix are dilated and remain so, thus enabling us to examine and remove the piece, especially with the aid of chloroform. But cases do occur in which it is necessary to dilate the uterus before this can be done.

Last year I had three cases at the same time under my care in Guy's Hospital. In every instance there was a history of a miscarriage at the third or fourth month, with hæmorrhage from the uterus, on and off, ever since. I dilated with laminaria tents, gave an anæsthetic, and removed the piece, the hæmorrhage at once ceasing and the uterus regaining its normal size under the influence of ergot. Two of those patients have become pregnant again. But cases occur in which there is hæmorrhage from the uterus, a history of miscarriage and a somewhat enlarged uterus, and yet there is nothing left behind. These cases may be mere instances of subinvolution, but at all events the bleeding does not stop on the administration of ergot. In several such cases I have dilated with tents, found nothing inside the uterus, and yet the hæmorrhage has at once stopped and has not recurred. The mere dilatation and irritation set up by the tent seemed to have acted beneficially. In some instances I have applied tincture of iodine, iodized phenol, and other caustics, by means of a probe wrapped with cotton wool.

The best plan for exploring the intra-uterine cavity is to dilate the uterus and cervix sufficiently to admit the forefinger. The patient is then anæsthetised and placed in the lithotomy position. The right forefinger is passed into the

uterus and moved in such a manner as to bring the fundus forwards. The left hand can then easily manipulate the fundus above and push it down on to the examining finger. In this way every part of the cavity of the uterus can be explored without having more than one finger in the passages. In some instances, as where the uterus cannot be brought forwards, it is necessary to pass the whole hand or a part of it into the vagina in order to enable the forefinger to explore the uterine cavity.

For making intra-uterine applications the best plan is to pass a Sims' speculum with the patient lying in the left lateral position. Then the anterior lip of the cervix is seized with a double uterine tenaculum and a little traction made, so as to bring the os uteri low down. In this way it is very easy to put a wire over a polypus, scrape out the uterus with a curette, or make applications by means of a probe or other instrument.

Case 3. *Fibroid of the uterus; sloughing; dilatation; removal by enucleation.*—J. T—, æt. 53, a married woman, came to my out-patients' at Guy's Hospital in July, 1884. She had been pregnant three times. Labour induced at seventh month with the two last. The first one was craniotomised. For nine or ten months she had had almost constant sanguineous discharge, and had noticed a lump in the lower part of the abdomen. Her periods used to be quite regular every four weeks, lasting three or four days.

On examination, a hard tumour was found in the pelvis and abdomen, reaching as high as the umbilicus and moving rigidly with the cervix uteri. The sound passed five inches and a half with the concavity forwards. Ergot in half drachm doses of the liquid extract was administered. This seemed to set up considerable action in the uterus, and the patient became so ill that she was taken into the hospital. She had a foul discharge and a high temperature. After a day or two it was found that the os uteri was dilated and a black, sloughy mass protruded. This was easily broken off, leaving more behind. A wire écraseur was passed into the uterus and as much as possible of the growth removed.

The patient had a rigor, the temperature rose to 104·4°;

tongue dry and brown; pulse feeble. Next day an anæsthetic was given and I passed my hand into the vagina and my finger into the uterus, where I could feel a large fibroid on the posterior wall with a polypoid outgrowth into the uterine cavity. I removed some of the outgrowth, but there was not sufficient working room. Uterus syringed out with carbolic lotion. Liq. Ferri Perchlor. (B.P.) applied to uterine cavity.

Three days later some more pieces removed, but as there was evidently more to come, three laminaria tents were introduced into the uterus and left for twelve hours, then a water dilator (Barnes's) was substituted for an hour and a half. This enabled me to get two fingers into the uterus and I managed to enucleate a portion of the fibroid. There was still some left behind, but I found it impossible to get it away.

The uterine cavity was washed out with carbolic lotion (1 in 60) and then swabbed with Liquor Ferri Perchlor. (B.P.).

From this time she rapidly improved. Ergot was again given, all bleeding stopped, and the tumour subsided so as only to reach midway between the umbilicus and the pubes, the sound now passing only three and a half inches.

She left the hospital practically well, and I have seen her on and off since. The uterus and tumour have been diminishing in size and can only just be felt above the symphysis. She has had no further hæmorrhage nor pain and does a great deal of work.

Case 4. *Retroflexion and retroversion of the uterus resisting ordinary methods.*—E. D—, æt. 34, married nine years, never pregnant, complains of pain in the back which she has had for eighteen months. Periods have been more profuse and of longer duration and accompanied by more pain.

On examination the uterus was found to be retroflexed and retroverted. The sound passed the normal length with increased concavity backwards and with the handle too far forwards. The fundus was fairly easily restored to its normal position by means of the sound and the finger. A Hodge's pessary was passed into the vagina over the sound

and the latter removed. A week later she came again and the uterus was as badly retroflexed as before. Reduction by the sound again effected, and a larger pessary applied. This kept it up pretty well for a week, but the uterus again got back to its old position. She was therefore taken into the hospital, where I passed a vulcanite stem pessary into the uterus, and kept her in bed for a few days. On the fourth day the stem was removed, and a Hodge's pessary was put in. This was subsequently changed for a smaller one, and the patient allowed to get about. The pain had left her, and I have seen her several times since; she is very much better and the uterus keeps in good position.

In deciding upon the question of the propriety of dilating the uterus, it is necessary to take into consideration the contra-indications.

As a rule in the presence of acute or chronic pelvic cellulitis or peritonitis dilatation should not be attempted, as it would very probably light up fresh inflammation. At the same time it is sometimes advisable to run that risk, as in cases of septicæmia with inflammation. If, for instance, a patient after parturition begins to suffer from septicæmia, and on examination there is evidence not only of pelvic inflammation but also of decomposing remains in the uterus, it is advisable to dilate up sufficiently to remove the decomposing remains. If, however, there be no foul discharge from the uterus it is better not to interfere. It often requires careful judgment. In the following case it was decided not to dilate.

Case 5. *Metritis (?) following parturition.*—In May I was asked by Dr. Percy Warner, of Woodford, to see a lady with him. She was a multipara, and had been confined a week previously. She had been gradually getting worse, and finally got alarmingly feverish. On my arrival the temperature was 104° F., the pulse rapid, the abdomen tender above the pubes. Vagina hot, uterus very tender, os externum closed, no foul discharge. No thickenings in the broad ligament.

In this case we diagnosed metritis without septic source in the uterus, or at all events anything which it was desirable to

attempt the removal of by dilatation. We washed her out and took every antiseptic precaution, and gave her quinine, &c., and though she was in a grave condition she pulled through and got quite well again. I believe that if tents had been used in this case the result would have been deplorable.

Inflammation of the lining mucous membrane of the uterus (cervical and fundal) is often greatly benefited by dilatation, the use of the sponge tent being specially indicated. But it is when the endometritis is chronic and unaccompanied by metritis that such treatment is advisable.

One of the best uses of tents is in the removal of an ovum and its appendages in the early stages of pregnancy, when for some medical cause abortion is desirable. Every medical practitioner has had cases of hæmorrhage coming on in the early months of gestation, say the sixth to the fourteenth week. In some instances the danger is averted by means of rest and opium; in others the patient aborts without much trouble and soon gets all right again; in a few the hæmorrhage goes on without producing abortion and the patient gets weaker and weaker. It is in these cases that it is necessary to do something. I know many who give ergot, and it undoubtedly succeeds sometimes. I myself have had many of these cases in consultation and in hospital practice and have never had a bad result when I have dilated with tents and cleared out the uterus.

If the cervix be sufficiently patent to allow the finger to pass in, then the cavity should be cleared of its contents without waiting for the dilatation of tents. If, however, some dilatation is requisite, the putting in of a tent not only produces the dilatation, but also promotes contraction of the fundus, and, what is of the greatest practical importance, absolutely stops all further bleeding. A friend of mine, a practitioner in a suburb of London, had one of these cases of persistent hæmorrhage in early pregnancy, and after trying rest and sedatives in vain, determined to sacrifice the ovum. Having obtained the consent of the parents he passed a catheter into the uterus and left it there, believing that this would set up sufficient uterine contraction not only to expel

the ovum, membranes, &c., but also to stop all further bleeding. When he came next day he found the patient dangerously blanched, the catheter still in the uterus, and bleeding going on. He came up for me in great haste, and although I was back at the patient's house with my friend in less than an hour, she had lost over a pint of blood in the interim. She was in a very desperate condition, and we commenced to give her chloroform; but we had to desist, as we thought she was dead. I rapidly cleared out the uterus, the cervical canal being sufficiently dilated. The ovum was about two and a half months old. The placenta was partially detached, but was adherent near the fundus. As I was removing the last bits I felt the uterus contracting on my finger. We gave her a little brandy, and kept her perfectly still for several hours. She did not lose another drop of blood and got better without a bad symptom; but she ran a terrible risk which might, I think, have been avoided by adopting some such method as in the following case.

Case 6. *Hæmorrhage in the early months of pregnancy.*—Last June I was asked by Dr. Noad, of Tulse Hill, to see a patient with him. She was twenty-eight years of age and three months pregnant. She had been bleeding from the uterus for six weeks in spite of the various palliative measures, rest, opium, and hæmostatics which were resorted to. On examination I found that the os uteri externum was closed, and some watery blood was oozing from it. With the above history, and the patient already getting weak, we advised interference and I was asked to undertake it. I dilated up with tents, and with the assistance of Dr. Noad, who gave chloroform, and of Dr. ——, the patient's brother, I cleared out the ovum and its membranes, placenta, &c. She made an easy recovery.

I have had many cases like the above, and in no single instance has there been a bad result. I have, however, seen death result by delaying a long time in the hope of saving the child. This, however, is not the point under discussion. What I wish to lay stress upon is that when it has been decided that interference is necessary, then the insertion of

a tent preparatory to removing the uterine contents is the best practice.

Cases of dysmenorrhœa are not unfrequently relieved by dilatation of the uterus. It has been shown that in some instances of so-called mechanical dysmenorrhœa, that is, painful menstruation due to a mechanical obstruction to the menstrual flow, there is no obstruction to be made out inasmuch as a uterine sound can be passed easily, even when the flow and the pain are on. Whatever the true pathology may be, there is no doubt about the fact that mechanical dilatation frequently affords relief.

Sims's or Priestley's dilators, or, better still, the more modern graduated steel bougies, find here their most useful employment. I have tried them all, but as I am convinced of the more permanent benefit of Sims's method of slitting the cervix backwards, it is not often that I resort to dilatation, which has to be repeated every month.

The following case will illustrate both points :—

Case 7. *Dysmenorrhœa and sterility.*—E. B—, æt. 32, came to my out-patients' at Guy's Hospital in 1883, suffering from intense pain at her monthly periods. The pain was so severe that she was obliged to take to her bed for a few days every month. For nearly twelve months she had been every month to an obstetric physician, who dilated the womb and gave her much relief, but she was unable to afford the fees any longer and so presented herself at the hospital. She had been married several years, but had never been pregnant. The uterus was congenitally anteflexed to some extent. The sound passed, without difficulty, the normal length. I recommended her to have the cervix slit backwards to relieve the dysmenorrhœa. She did not care at all about the sterility, and I told her that the operation did not relieve this condition, at least in the majority of cases. She consented, and I performed the operation with Küchenmeister's scissors and Sims's knife. She would not take an anæsthetic and the pain was not very great. She was only in bed one week.

In August, 1885, two years after the operation, she wrote to me and said, "Your operation has been a great success."

I was glad to hear this so long afterwards, because, although the relief to the dysmenorrhœa when the operation is done in the proper cases is always well marked, the pain not unfrequently returns after twelve months or more. The slit will generally be found contracted up again to some extent, and it can be readily broken down by the finger or a sound, though occasionally it requires a knife or scissors.

That uterine dilatation is not free from danger when effected too rapidly, or by improper means, or in unsuitable cases, will be most strikingly manifest by a mere enumeration of sequelæ traceable directly to this cause ; shock, collapse, lacerations of cervix and vagina, with fatal hæmorrhage, general peritonitis, pelvic cellulitis (parametritis), pelvic peritonitis (perimetritis), metritis, endometritis, cervical inflammation, pyæmia, septicæmia, and tetanus.

In this formidable list occur several diseases which are usually fatal.

The only bad result I have personally had so far was a case in which after dilatation with a laminaria tent for the purpose of intra-uterine medication, a sharp attack of pelvic cellulitis in the left broad ligament came on. This I believe was entirely due to the bad sanitary condition of the ward, for every case operated on at that time did badly, and in one case the mere puncture of some ovula nabothi resulted in a suppurative pelvic cellulitis which very nearly proved fatal. In my case suppuration did not supervene, but it was twelve months before the inflammatory exudation became absorbed. It was found that the drain-pipe of the water-closet was defective. My colleague, Dr. Galabin, and myself postponed further operations until it was remedied, and I have not had a bad result since. At no time have I had a bad result in private practice.

CASE OF PULSATING SARCOMA,

INVOLVING LEFT NASAL FOSSÆ, ANTRUM, AND ORBIT.

By C. HIGGENS.

Notes of the Case by Mr. F. W. FOSTER.

Thomas H—, æt. 66, admitted into Barnabas Ward on June 9th, 1885, for a circular pulsating swelling beneath inner canthus of left eye, and very much resembling in appearance and situation a lachrymal abscess.

Family history.—Good.

Occupation.—Working ironmonger.

Previous health.—Good, he never ailed anything up to the age of fifty-two, and was a hardworking man. He has been married twice, and the second wife is still alive.

At the age of fifty-two he had a severe attack of epistaxis and had to seek medical aid, when plugging was resorted to. Seven years later (at the age of fifty-nine) he had another and severer attack, and was taken to St. George's Hospital from his work. He was admitted and retained four weeks; no plugging was resorted to this time, but tannic acid was applied to interior of left nostril.

After being discharged he continued to have smaller attacks every two or three months. When on March 22nd, 1885, he was overtaken while at work by another

severe attack, and was taken to the Middlesex Hospital, the anterior nares were plugged and the hæmorrhage was brought under control; this mode of plugging was kept up for a fortnight, the hæmorrhage recommencing at each removal of the plugs.

On the fourteenth day the hæmorrhage broke out as profuse as ever from the posterior nares, while the anterior nasal plugs were still *in situ*. Both anterior and posterior nares had then to be plugged. During the plugging the patient felt a sharp pain in inner canthus of left eye, in his throat, behind angle of jaw on same side, and his left ear became deaf; a day or so later he noticed a small swelling below inner canthus of left eye which pained him. The plugs were removed on the fourth day, and the patient was kept in the hospital for the next six weeks, and no recurrence of hæmorrhage having taken place in this time, he was discharged, still retaining the swelling above mentioned.

The swelling went on increasing, and he sought admission into Guy's Hospital under Mr. Higgens's care, and was duly admitted on the date mentioned above.

Condition on admission.—He is a man about 5 ft. 5 in. in height, has lost the greater part of his hair; what remains is quite grey, but the original colour appears to have been brown. He weighs 7 st. 8½ lb., says he weighed 10 st. 4 lb. twelve months ago. There is no abnormality about urine, and the physical signs, in lungs and heart, are what they should be. He has a circular pulsating swelling beneath inner canthus of eye encroaching somewhat on bridge of nose. It has a nodular projection or bud from its upper part, just outside its perpendicular equator. This bud is as large as a good-sized pea, and projects over the inner canthus; the punctum, however, is clear and looks apparently healthy. The horizontal and perpendicular diameter of the main swelling is one inch. The left nostril is blocked by the tumour, but it does not extend into the pharynx. The pulsation is largely diminished by pressing on the common carotid of the same side, also by pressing upon the left facial artery. The pulsation is synchronous with the heart's action. No bruit can be heard over swelling, or on any part of the head, nor is there any complaint

of buzzing or noises in the head, as noticed in cases of vascular protrusion of the eyeball.

Treatment and progress of case.—The man being in a weak state from his previous severe epistaxis, he was put on ℥vj of port a day, full diet, and the following general tonic prescription was ordered :

℞ Tr. Ferri Perchlor. ♏xx,
Quiniæ Sulph. gr. ij,
Acid. Sulph. dil. ♏v,
Sp. Chlorof. ♏x,
Aq. ad. ℥j ter die.

June 12th.—The pulsating swelling gets slightly larger. The man has a fairly good appetite, and walks out in the grounds every day.

15th.—Swelling has got rather more on to the cheek and is much redder than it was.

17th.—Patient had very profuse epistaxis soon after one this morning. The sister described it as being like water from a kettle spout. The house surgeon was sent for, and he, with the assistance of the ex-dresser, plugged the left posterior and left anterior nares. They had considerable difficulty in getting the posterior plug in position, but after some few minutes they were enabled to completely arrest the hæmorrhage, and tannic acid was then blown into the right nostril.

The man is exceedingly weak this morning. The swelling has very much increased and the pulsation is more marked.

At 4.30 p.m., I made an attempt to remove anterior plug, but found the hæmorrhage would recur, so left it *in situ*, but washed away all clots with carbolic lotion, and applied iodoform powder to keep him sweet for the night. He says he feels comfortable, but has only taken half a pint of milk since the hæmorrhage. I left him at 5.10 comfortable for the night, and sent the condition of affairs to Mr. Higgens. A few minutes after I had gone, Mr. Lucas, at the request of Mr. Parsons, the house surgeon, ligatured the common carotid. Chromicized catgut was the ligature used, which was cut short, and the external wound closed with five S wire sutures.

18th.—This morning there is slight pulsation in the

swelling, also in left temporal artery. Temperature normal, pulse 100 per minute, exceedingly weak and feeble. He has taken a pint of milk since last night and an ounce of brandy.

19th.—The man has improved since yesterday. His temperature is still normal, and his pulse is stronger and less frequent; he complains of pain in the swelling. Takes his egg and milk freely. No symptoms of hemiplegia.

This afternoon the man was dressed, and the wound had healed by primary union and there was not an atom of discharge.

20th.—The swelling is larger and redder; the nodule described above is now the size of a marble, and there is another one the size of a pea a quarter of an inch external to this one, and on a level with its lower border. They are white in appearance and present distinct fluctuation. There is no pulsation in the swelling, there is distinct pulsation in left temporal artery, but it is not so full as opposite side. Patient is comfortable and takes plenty of milk and egg. Temperature 99·6°, pulse feeble, but regular.

21st.—I dressed him again this morning, and removed one suture which seemed rather tight. There is still no discharge. The dressings are done under the spray, green protective being placed next to the wound, oil gauze over that, then dry gauze followed by gauze bandage, and finally strapped and bandaged with ordinary bandage. Pulse stronger, temperature 98·8°.

22nd.—There is distinct pus in the two nodules mentioned above and semi-fluctuation in the swelling, but no pulsation; the swelling feels altogether softer than it was. The left side of the head feels distinctly cooler than the right, and the pulsation in the left temporal artery is still much weaker than the right. Appetite good, takes plenty of egg, milk, and beef tea. Pulse good, temperature 98·4.° No signs of hemiplegia.

23rd.—I dressed patient again this morning. Wound looks healthy and seems to have quite healed, no trace of discharge. Appetite good. Pulse good, temperature normal. Bowels open with enema simplex last night.

24th.—Patient sleeps fairly well. The two nodules are more prominent and quite of a yellowish-white tint. The

main swelling is also more prominent and has slight pulsation. Patient eats well, had some fish yesterday, and always feels ready for his meals. There is scarcely perceptible difference in the temporal pulsations, and they seem quite synchronous. The left side of the head is now quite as warm as the right. Temperature 99°.

25th.—This morning, between two and three, the sister was called to the man by the nurse; he was sweating profusely, more especially from head and arms; his head and feet were quite cold; a hot bottle was put into the bed, and warm sponges applied to his head, and the man rallied after a time. He seems much weaker, and the pulse in left temporal is not so good and is felt with difficulty; he has a slight cough. I have dressed him and removed the four remaining silver sutures. The wound has quite healed. The tumour gets a little softer and the pulsation continues in it. Temperature 98°.

27th.—I dressed him again this morning; wound has quite healed. The skin has sloughed off the smaller nodule, letting out a small quantity of pus and exposing some weak granulations. The larger one is commencing to slough, and is discharging a small amount of pus. The growth is getting larger, softer, and redder, and has slight pulsation. The pulsation in left temporal is better this morning. Patient complains of pain in left eye through pressure of the growth, which is beginning to displace the eyeball outwards. The man can grasp as tightly with his right hand as with his left and has done so all along. Temperature 97·8°.

29th.—Tumour increasing and is giving great pain by pressing upon eyeball. Patient complains of headache this morning and had no breakfast. He spat up a small quantity of blood first thing, which apparently had run from the nose into the pharynx. The pulsation is better in left temporal and is stronger in the tumour.

July 1st.—In the night patient was very ill for two hours; it was a similar attack to the one mentioned above, and the same treatment was resorted to. He was quite unconscious during the two hours. He took very little breakfast this morning and seems much weaker. He complains a good deal of his eye.

3rd.—Last evening patient spat up about two ounces of blood; he said he felt it running into the back of his throat and then spat it out. The first quantity was dark in colour, the next a bright red.

4th.—I dressed the wound again this morning and only put on a piece of lint for protection. The man seems weaker and does not take his food quite so well. The swelling is larger and the upper nodule is growing rapidly, the skin is sloughing off it, and it keeps discharging. He complains a great deal of his eye.

6th.—Lint soaked in belladonna and glycerine was ordered to be kept on tumour to-day.

7th.—Left off all dressings this morning, and patient is sitting up in a chair beside the bed. He has a very good appetite.

8th.—Patient sat up nearly the whole of yesterday and feels better for it. Had a good night's rest, and says the belladonna has eased his pain. He is up again to-day.

9th.—The upper nodule of the growth was bleeding a little this morning, so patient was kept in bed, but he is going to get up again after dinner. The pulsation in the tumour is stronger; the patient himself gains strength rapidly, and this seems to hasten the growth of the tumour.

11th.—Patient seems rather weak this morning, and complains of a good deal of pain in his eye; equal parts of boracic acid and starch are being applied. His bowels were open last night with enema simplex. Tumour pulsates strongly. Patient walked a few steps round the ward yesterday afternoon, with assistance, and again this afternoon.

13th.—Patient was walking again yesterday afternoon with assistance, but to-day he has been going by himself. The swelling is not quite so large, and it feels somewhat softer. It has been discharging two or three ounces a day, for the last three or four days, purulent-looking stuff mixed with blood. He is still deaf with left ear, and says at times he can scarcely hear himself speak. Appetite good. His bowels have acted the last three days without assistance.

15th.—Patient had a very bad night last night, says he had a suffocating sensation and could scarcely breathe at

times. He is walking about the ward to-day. Bowels regular. The tumour bleeds a little from time to time from the points of ulceration mentioned above.

18th.—Patient has had no sleep for the last two nights, through the pain in his eye, which is being gradually pressed towards outer wall of orbit. He still complains of the suffocating sensation at night. He walks out in the park now daily. Liq. Morph. Hyp. ɱiij nocte.

20th.—Patient has slept well after the injection the last two nights. His bowels have not acted for three days.

22nd.—Bowels were open yesterday with castor-oil. The cornea has now started to ulcerate. Guttæ Eserinæ ordered, and the injection to be repeated every night.

23rd.—The tumour has spread for half an inch on to cheek. There are two points of ulceration on upper part of growth, one the size of a shilling, which is the inner one, the other the size of a sixpence; they occupy the sites of the two nodules mentioned above. Patient could not bear the eserine—it gave him intense pain.

August 4th.—The pain is getting more intense; ordered gr. ¼ Inj. Morph. Hyp. p. r. n., and gr. ⅓ omni nocte, and brandy ʒiij; he is much weaker and thinner, and his appetite is not so good.

17th.—Patient still goes out daily, suffers a good deal of pain. Fotus Papaveris ordered for the growth.

22nd.—The growth is very much injected and red, and now extends somewhat to the right of the bridge of the nose and two and a quarter inches on to left cheek, towards malar bone, and is about two inches from above down. The upper edge is pressing against upper eyelid, which is beginning to be red and inflamed at its inner part. There are still the two patches of ulceration mentioned above, which are slightly larger. The centre of the tumour has a forward projection of a quarter of an inch more than bridge of nose. The whole growth is still more or less circular with a radius of one and a quarter inches. There is distinct pulsation in the growth, which is stopped by pressing on right carotid. He complains of a good deal of pain, and there is a quantity of discharge from the growth daily.

31st.—The dose of the injection has been increased to gr. ss

omni nocte. Diet altered to fish or meat, two eggs, milk Oj, beef-tea Oj.

September 4th.—Condition very much the same, growth increasing. Mist. Acidi Co. ℥j ter die. Beer added to his diet.

18th.—Growth now measures two and three quarter inches from side to side and two and a quarter from above down. The patches of ulceration described above are still discharging a good deal. The smaller one has been bleeding for the last three or four days. The growth is now deep red in tint and bulges forward for half an inch beyond bridge of nose, and also bulges into left nasal cavity. The swelling is soft and elastic, and seems to be devoid of pulsation. There are a number of white points over the growth, which look like the commencement of further ulceration. He has very great pain in his eye, which is now crowded into upper and outer cornea of orbit; he is getting much weaker, and his appetite is beginning to fall off very much; he is very much emaciated, and his hands always feel as cold as clay. The growth is dressed twice daily with belladonna and glycerine. He still walks out into the park daily. The upper eyelid is now involved in growth.

22nd.—Tannic acid ordered to be applied to bleeding points of tumour. It is now dressed thrice daily, first washed with boracic lotion and then the belladonna and tannic acid applied.

23rd.—The ulcerations are all bleeding now, and there is a large quantity of yellowish discharge. This morning the bleeding was profuse. He complained of soreness over his sacrum. Upon examination a circular red patch was noticed about the size of half-a-crown piece, looked like a commencing bedsore. Spirit lotion was applied.

24th.—The bleeding has stopped, and the red spot mentioned above is improving under the treatment. Appetite is falling off. Pain greater.

October 2nd.—Ol. Eucalypti ordered to be used for dressing. A grain of opium to be given ter die. Morph. gr. ¾ o. n. and s. o. s. Beer. Chicken and Oj of beef tea ordered; in fact he has been indulged all along, having anything he fancied.

3rd.—The eucalyptus gave him such intense pain that the old dressing had to be resorted to.

6th.—The patient has been rather stupid the last three or four days, but this I think is due to the opium, morphia, &c., as his pupil is somewhat contracted, and he seems drowsy. He has been unable to open his left eye for the last month or more, and now it is difficult to see it at all.

8th.—The growth now has the following measurements:—from above down, two and a half inches; transversely, three inches. The two diameters bisecting the angles formed by the junction of the above diameters are also three inches, and it has an elevation at its upper part of three quarters of an inch, at its lower of one inch. It has the appearance of having fallen in above and become somewhat pendulous below. The two ulcerating surfaces mentioned above have now coalesced into one, forming an unhealthy granular surface two inches by nearly three quarters of an inch, sloping somewhat outwards from position of inner canthus. There are several small similar surfaces along lower part of tumour. The eyelids are thick and œdematous, and the position of the eye is denoted by a slit-like depression at upper and outer angle of orbit. He complains of a grinding pain in his ear, eye, and left nostril, where the growth can be seen protruding, also in left side of head and upper lip. It is washed daily with boracic acid lotion. Right apex duller than left and presents tubular breathing; the whole of right lung behind has a lower note than left, and there are some fine crepitations at the base. Urine high coloured, no albumen, no sugar, contains a quantity of urates. Patient only remained up in the ward a short time and then went to bed again.

9th.—Last night his breathing could be heard rattling all over the ward, and he has a good deal of dyspnœa this morning; all opium has been stopped and he is having half an ounce of brandy every hour; he is in a very weak state, and seems only semi-conscious. There is marked tubular breathing at right apex; he is too ill to examine further.

10th.—There is increased dyspnœa this morning, and patient has taken nothing since yesterday at dinner; pulse very feeble and he seems to be sinking. He died at 3.15 p.m.

Post-mortem examination.—Recent pleurisy on left side, also an old scar. Broncho-pneumonia apex right side, and more or less distributed through right lung. Left side œdematous. Calcareous patches in aorta and two large calcareous nodules near semilunar valves.

Roof of left orbit gone; cavity the size of a walnut just under dura mater full of pus, dura mater very thin over it; this cavity communicates with frontal sinuses. Pus running into pharynx from left side of nose. Inner wall and floor of orbit gone for distance of one inch. Nasal process of superior maxilla gone. Nasal bone of left side has begun to be eroded. Inner wall of antrum gone, growth fungating into antrum, and the latter cavity contained pus. Whole of outer wall of left nasal fossa destroyed, growth bulging into latter cavity. It extended into orbit as far as posterior surface of globe; globe pressed upon but not involved.

Condition of ligatured vessel: Parts scarcely looked as if they had been disturbed, and there was the depression on the artery where the ligature had been, but no trace of it could be detected. The vessel was quite occluded below the ligature for three quarters of an inch, and partially occluded for another quarter of an inch. Above it was occluded for one and a half inches, that was up to the bifurcation.

There were no secondary growths in the organs and no enlarged glands.

The microscopic examination of the growth made by Dr. Carrington and Mr. Foster showed it to be a spindle-celled sarcoma.

Remarks.—The first point of interest in the foregoing case was as to diagnosis. On first seeing the patient I thought I had to deal with a rather large lachrymal abscess; the situation of the tumour, near the inner canthus, and its dusky appearance leading one at once to such a conclusion. But a digital examination at once detected, not fluctuation, but strong pulsation, showing at once that I had no lachrymal abscess to deal with.

The next inference was that I had to do with aneurysm in some form. The history of pain, during the operation of plugging the posterior nares, followed in the course of

the next few days by the appearance of the swelling, gave a colourable excuse for my thinking that I might have to do with a traumatic aneurysm.

Further examination, however, showed the true nature of the disease, viz. that it was a pulsating sarcoma, which had commenced in the left nasal fossæ, probably spread along the lachrymal canal and appeared as a tumour, at first distending the lachrymal sac, but afterwards ulcerating through to the surface.

The course of growth was somewhat unusual. If we suppose that the first commencement of the tumour was coeval with the first attack of epistaxis—fourteen years—or even with the second—seven years—before I saw the patient, its disposition must have widely changed in the last few months of its life. For up to the last six months no tumour appears to have been noticed, whilst during the time the patient was under my care its increase was extremely rapid.

Another point of interest is the very slight disturbance caused by ligature of the common carotid. Not one unfavorable symptom occurred; the wound had healed and the patient had practically recovered from the operation before the end of the second day after its performance, and his life was certainly prolonged by it for months.

A question which has more than once presented itself to my mind is whether or no some attempt should have been made to remove the growth. It seemed practicable, but I did not think advisable.

DESCRIPTION OF PLATE,

Illustrating Mr. Higgens' Case of Pulsating Sarcoma.

Fig. 1 shows the condition of the growth at time of admission.

The drawing, Fig. 2, was taken shortly before death, and shows the increase of the superficial portion of the growth in a period of less than four months. The irregular patches shown in this figure, which are marked *a a*, represent ulcerated surfaces.

Plate II.

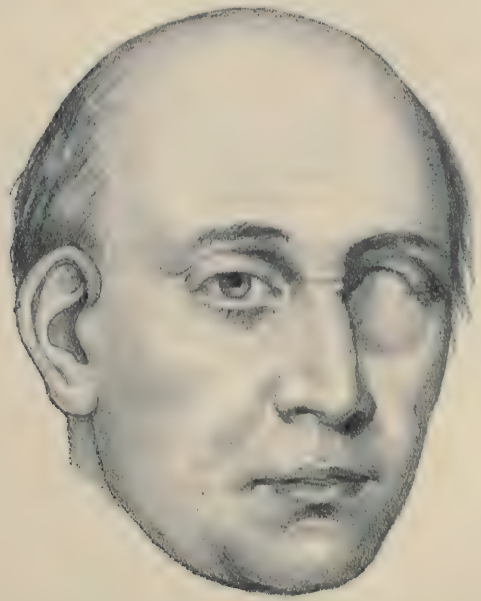


Fig. 1.

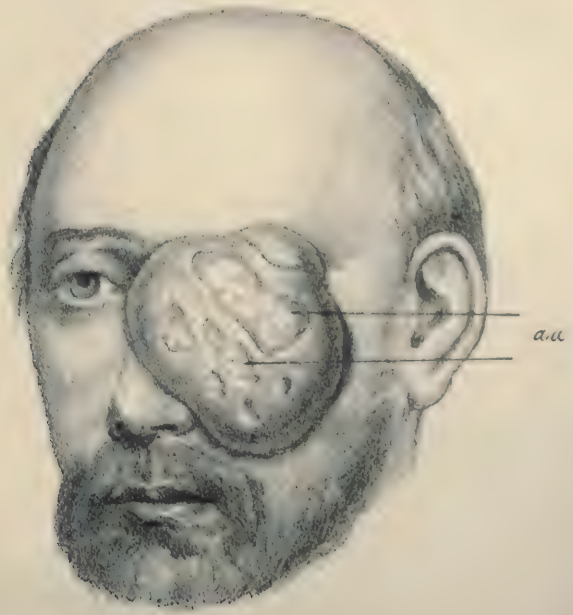


Fig 2.

ON THE

CHANGES IN THE VASCULAR SYSTEM IN BRIGHT'S DISEASE,

DEDUCED FROM

AN ANALYSIS OF THE POST-MORTEM RECORDS OF GUY'S HOSPITAL FOR THE TEN YEARS 1873—1882.

By JAMES F. GOODHART, M.D.

In examining our post-mortem records for the purpose of preparing the Bradshawe Lecture lately delivered before the College of Physicians,[1] I obtained some information which, although it adds perhaps nothing new to the controversies which have centred around "arterial tension," is yet, I think, of importance in itself as an analysis of a large amount of material, bearing upon pathological questions which are at all events not wanting in importance.

The ground I traversed was that of renal disease for the ten years 1873-82. It will be acknowledged to be of sufficient extent since it comprises 344 cases of granular kidney and 196 of parenchymatous nephritis. It also involved the consideration of such series of other cases as apoplexy and that general thickening of the vessels which of late years has been called arterio-capillary fibrosis, after Sir William Gull and Dr. Sutton.

[1] "Arterial Tension, a Review," published in the Medical Journals of August 22nd, 1885.

My colleague, Dr. Galabin, was, I believe, the first to contribute, from the post-mortem records of Guy's Hospital, an important item towards the solution of the question of what is the relation between chronic renal disease and hypertrophy of the heart, by showing that the hypertrophy is not confined to cases of granular kidney, but occurs in a definite proportion of such as used to be called tubal nephritis or large white kidney, but are perhaps better described as chronic parenchymatous nephritis.

He took the four years 1868-1872, and thus writes :[1]—"The general conclusion is that hypertrophy of the left ventricle belongs especially to a granular kidney, but in some considerable degree also to tubal nephritis of long standing."

I have followed on for the next ten years, 1873-82 inclusive, with the result of more than confirming the accuracy of Dr. Galabin's conclusions, as will be seen by the perusal of the following tables and the remarks which accompany them :—

Weight of heart in all cases in which the kidneys have been described as white or mottled, whether large or contracted, except such as were lardaceous.

Weight of heart in ounces.			
Under 8 oz.	31	51	
8—10	20		
10—11	20		85
11—12	14		
12—13	17		
13—14	14		
14—15	15		
15—16	13		
16—17	10		
17—18	6		103
18—19	5		
19—20	4		
20—25	10		
25—30	4		
Hypertrophied, but weight not given	5		

Now, if we consider 10 oz. to represent a fair average weight of heart, 51 only were below this, or hardly more than a quarter of the whole number. But I am not prepared to think that such would be quite a fair statement of the case,

[1] 'On the Connection of Bright's Disease with changes in the Vascular System,' Smith, Elder and Co., 1873.

because although 10 oz. may be a fair average weight of heart taking all cases together, yet the heart perhaps more than any organ, if we would obtain a true estimate of its size for the individual, requires to be estimated as a proportion of the body weight, and not upon a general average. This is not possible for statistics, therefore it is safer to take a higher average than 10 oz., say 12 oz. This gives 85 cases of average weight out of a total of 188 cases. From this, however, some deductions must be made. Of 31 cases in which the heart weighed less than 8 oz., 17 were children, all under thirteen, and all but 3 under twelve years; in one of these the left ventricle is described as thick. Ten others died of wasting diseases, phthisis, hepatic cirrhosis, cancer, ovarian disease, and diarrhœa; so that in 4 only the heart was small, and unaccountably so.

Of weights between 8 and 10 oz. there are 20 cases, but 7 of these are under sixteen years, all females but one. The heart may well have been large in these cases; it was certainly of average weight, and in one case, a female aged thirteen, weighing as it did 9 oz., it was certainly large. Of the remainder 3 died of phthisis, a wasting disease, 2 of old syphilis, akin to it in this matter, and in the case of one female, aged twenty, the heart is stated to have been hypertrophied. Between 10 and 11 oz., again 20 cases, 4 females and 2 males are under eighteen years, and in 3 of the former the heart is stated to have been hypertrophied. In 4 others the left ventricle was hypertrophied, and 2 others died, one of joint disease, the other of cirrhosis.

Between 11 and 12 oz. there are 14 cases, 2 being under age (eighteen years and fourteen years, the latter having hypertrophy), 4 others having hypertrophy, and 2 dying of wasting diseases. Thus, of the total of 85 cases, which were, *apparently*, of average weight, 25 may be excluded, the data being insufficient for comparison, the subject being under age—an exclusion which certainly militates, though probably not very much so, against the conclusion which is favoured by the figures.

Six other cases must be taken from the remainder and added to the side of hypertrophy, and 19 others may be deducted as dying of wasting diseases. This also is to some

extent a deduction which is not altogether fair. In renal disease the heart hypertrophies, but I have many times found that, given the supervention of a wasting disease, the heart wastes in proportion to the emaciation of the body, and although the heart is absolutely a small one nevertheless the left ventricle remains disproportionately thick. The figures come out then as 25 cases of chronic parenchymatous nephritis with a heart of average weight, and 109 cases in which there has been hypertrophy of the left ventricle, a proportion, that is to say, of over 1 to 4.

This result is an interesting one; it not only confirms the statement made by Dr. Galabin that hypertrophy of the heart is likely to occur in any case which has existed long enough, whether it be granular, as is most likely, or other; but it also seems to show that it is the general result, occurring that is to say in 80 per cent., and if so assuredly not confined to the most chronic cases as had been supposed.

There are great difficulties in arriving at any reliable information respecting the duration of this form of renal disease. Most patients seek admission to the hospital when they become dropsical, and in many cases dropsy is not a reliable indication of the date of onset of the disease, but taking this symptom as the most accessible, I find amongst many of many months' duration no mean sprinkling of illnesses of all lengths from three weeks to three months. The interest of this is as much physiological as pathological. We have been perhaps too much in the habit of regarding the rate of increase of the cardiac muscle as a slow one, and of considering that hypertrophy, once produced, is either stationary or leads to subsequent degenerative changes. But there can, I think, be little doubt that the muscular wall of the heart, like other muscles, responds rapidly in favorable cases to the demand made upon it for increase of work, and that considerable hypertrophy may occur within but a few weeks. I recorded a case in point some years ago, in the 'Transactions of the Pathological Society,' vol. xxx, in which a heart weighed 19 oz. after an illness apparently of only three weeks' duration. Dr. Stone, in the Croonian Lectures for 1879, gave two examples which go to show that the rate of hypertrophy may be as rapid as nearly an ounce a week. Two other cases are also given,

but they seem hardly applicable to their purpose, the one particularly that it was a case of very old atrophy of one kidney. A few other cases have been published by the late Dr. Peacock and Dr. Quain, bearing on the same question, but there is little enough evidence anyway. For the reason previously alluded to, the indeterminate onset of the renal inflammation, these cases cannot be cited in support of any actual rate, which probably is very variable in different cases, as Dr. Stone's four cases of it show, but they do lend support to the general assertion that the rate of hypertrophy is sometimes a rapid one.

My own observations in the post-mortem room would lead me further to question the opinion that hypertrophy of the muscle is liable to be followed by degeneration. Dr. Ord, quoted by Dr. Stone in the before-mentioned lectures ('Lancet,' vol. ii, 1879, p. 864), puts this view as well as possible :—"I have seen," he says, "many cases of great hypertrophy associated with training and athletics. With these comes arterial tension, probably as a protective arrangement. The hypertrophy, does not seem to be a bad thing while the exercise remains a habit, but when this ceases and a sort of involution of the heart takes place, I believe that disease often arises." I must confess to doubting this to be a sequel of simple hypertrophy both on the ground of *à priori* improbability and on that of such facts as are at our disposal. On the first head I am unwilling to allow that the heart muscle is physiologically different from other muscles in this respect, and it would be a bad day indeed for beings endowed with striped muscles if the pure hypertrophy, more or less, which is the necessary consequence of increased labour, led on to degeneration. The athlete increases his muscles in proportion to their work, and when the increase is no longer wanted it disappears, leaving him where he was before, less able to accomplish feats outside his usual range, but not less healthy than when in training. Surely the heart obeys the same law. Secondly, it can sometimes be shown that it does, when we find that a heart, small, but quite perfect as regard the quality of its muscle, gives evidence of having been hypertrophied. That this is no uncommon occurrence I have already said. At first sight Dr. Clifford Allbutt's observations on the atrophy of the biceps

which follows its over-action in Sheffield file-cutters[1] may seem to be opposed to this statement of the case, but it is not so. The case of the Sheffield file-cutter, who by rapid action causes his biceps to enlarge and *by the continuance* of his work brings about atrophy corresponds with the case of aortic regurgitation and similar instances, where the conditions which provoke the hypertrophy persist to the production of fatigue. There is no sufficient evidence to support the view that the file-cutter having produced hypertrophy and then left off his work is liable to be attacked by muscular atrophy. Atrophy comes in the course of work—the muscle, so to speak, dies in harness. And in the case of the hypertrophied heart of the athlete, which has degenerated upon involution, many things may have been present, such as atheromatous coronary arteries, valves strained short of incompetence or the earlier grades of dilatation, which are difficult to disprove; yet which, unless they can be positively excluded, render inconclusive the evidence, that degeneration is the outcome of simple hypertrophy.

I must further add that even in extreme dilatation with hypertrophy I have over and over again failed to satisfy myself of the existence of any microscopic evidence of muscular degeneration. For this reason I have long thought that dilatation is in many instances much more correctly expressed as the result of fatigue than as due to primary degeneration, and Cohnheim has propounded the same opinion.

It is generally believed that the granular kidney is a more potent force in the production of cardiac hypertrophy than any other form of nephritis, and this is true inasmuch as the chronicity, or rather the very gradual maturation of the disease or impairment of the function of the organs such as obtains in this form, is best adapted to the production of hypertrophy in its greatest perfection. The following table of the cases of granular kidney that have occurred at Guy's Hospital in the same ten years, if compared with the table already given, will show this.

[1] "The Effects of Overwork and Strain on the Heart and great Blood-vessels," 'St. Geo. Hosp. Reports,' vol. v, footnote p. 43.

Weight of heart in all cases in which the kidneys are described as granular, for the ten years 1873 *to* 1882, *inclusive.*

Weight of heart.	Number of cases.	
Under 8 oz.	11	103 cases.
8—10	40	
10—11	27	
11—12	25	
12—13	27	226 cases.
13—14	33	
14—15	19	
15—16	18	
16—17	27	
17—18	11	
18—19	17	
19—20	17	
20—25	36	
25—30	7	
Over 30	1	
Hypertrophic, but exact weight not stated ...	13	
	Total—329 cases.	

Of the 103 in which the heart, being 12 oz. or under, was within the limits of an average weight, 36 are nevertheless described as hypertrophied, and must therefore be deducted and placed on the other side. Forty-two others are adequately accounted for by old age or wasting disease. Thus no less than 12 suffered from cancer of one part or another (4 of them of the œsophagus), 18 others from phthisis, cirrhosis, &c. Nine were old people. Three were cases of mitral stenosis, which, by naturally tending to produce a small left ventricle, counteracts the tendency to enlargement which exists in renal disease.

Only 25 cases, therefore, fail to conform to the rule, against a total of 262 cases conforming, or presumably so—a proportion of 9 to 1. It must be remembered, however, that the period for the occurrence of granular kidney is later than that for parenchymatous nephritis, and that therefore this disproportion would perhaps require to be somewhat reduced on account of some few other conditions which late in life make for hypertrophy more than at an earlier age.

The incidence of the two forms of disease, both in respect of age and sex, is shown in the following table.

Chronic Parenchymatous Nephritis.

	Male.	Female.
Under 10 years ...	12	3
„ 20 „ ...	12	17
„ 30 „ ...	37	10
„ 40 „ ...	27	16
„ 50 „ ...	31	4
„ 60 „ ...	8	6
„ 70 „ ...	8	1
„ 80 „ ...	1	1
	136	58

Granular Kidney.

	Male.	Female.
Under 10 years ...	0	0
„ 20 „ ...	0	1
„ 30 „ ...	5	9
„ 40 „ ...	36	21
„ 50 „ ...	55	40
„ 60 „ ...	53	33
„ 70 „ ...	39	16
„ 80 „ ...	9	10
„ 90 „ ...	2	1
	199	131

Possibly these two tables do not represent the incidence quite accurately. So far as regards the granular kidney some still think that although rare in those under twenty it is hardly so much so as only to have been met with once in ten years in one of the largest of the metropolitan hospitals. It seems therefore necessary to say that this is a matter of interpretation. Some would call all kidneys granular which are small and irregular on the surface. A liberal gauge of this kind will considerably increase the number of cases occurring under twenty years. But if in the group of chronic parenchymatous nephritis there are allowed to be not only large smooth kidneys but also small shrivelled ones, as I think without doubt there should be, then the small red granular kidney is but seldom seen, and when I have met with it, it has been with a history of scarlatina many years before.

With respect to dilatation of the ventricle my impression had been that it predominated in chronic parenchymatous nephritis while hypertrophy does so in the granular kidney.

And it is seldom, perhaps never, that in the former such extreme degrees of simple hypertrophy, unaccompanied by dilatation, are met with as are seen in the latter. But dilatation of the left ventricle is frequent in both forms of the disease. I find 51 cases of notable dilatation of the left ventricle in the 344 cases of granular kidney, and 33 cases in 196 of chronic parenchymatous nephritis.

But in saying this I must reserve one group of cases, viz. that of children the subject of chronic parenchymatous nephritis. I have in a previous volume of the 'Reports'[1] called attention to the occurrence of acute dilatation of the heart in scarlatinal dropsy. And if now from this series of cases all those under sixteen be taken, there is further evidence of the correctness of the opinion I there expressed that in young people the risk of dilatation of the heart is more than in older people. There are 30 cases in subjects of sixteen and under, and the left ventricle was dilated in 13; the majority of the cases having been ill only a few weeks. The heart is said to have been healthy in 10 and atrophied once, and hypertrophy is noticed only six times.

Lardaceous disease of the kidney, although accompanied by nephritis, is well known not to be associated with hypertrophic changes in the heart or arteries. It seems worth while to note that the experience of these ten years conforms on the whole to that rule. I have noted 146 cases of lardaceous disease in that period. In 13 only was the heart over twelve ounces. In one of these it is described as enormously hypertrophied; in another it weighed 21 oz., the kidneys being granular. In 7 others it weighed 12 oz.

Cerebral hæmorrhage has long been recognised as the common associate of a granular kidney, but of late years the meaning of this has been called in question by the statement of Charcot and Bouchard that the hæmorrhage is due to a primary disease of the vessels irrespective of renal disease. I have fully discussed this in a former volume of the 'Reports' ("On Meningeal Hæmorrhage," vol. xxi, 1876), and again to some extent in the Bradshawe Lecture. I shall not re-enter upon it now except to say that in the ten years there have been 118 cases of apoplexy, and no less than 86 were accompanied

[1] Vol. xxiv, 1879.

by renal disease, and 12 by heart disease; 3 were associated with cerebral tumours; in 3 no adequate explanation was found, and only in 7 did bad vessels exist unaccompanied by other visceral changes.

It is well known that cases of chronic parenchymatous nephritis rarely die by cerebral hæmorrhage. There are only 8 such cases in the ten years, and 4 of these admit of question, being not improbably examples of granular kidney with some acute parenchymatous changes superadded.

Arterio-capillary fibrosis.—It has often been said that one of the difficulties in the way of accepting the conclusion that renal disease is a *cause* of hypertrophy of the heart and thickening of the vessels is the fact that both exist under certain circumstances with kidneys that are healthy.

Such cases do undoubtedly occur, but my experience of the last twelve years leads me to say that they are decidedly uncommon.

In the period I have taken for analysis (1873 to 1882) the following cases occur. I think it worth while to give a very brief note of each.

252. 1873. A man, æt. 50, a coaldealer; very intemperate; membranes very opaque. Old apoplexy. Heart 13½ oz. "No obvious cause for its increase in size" (Dr. Fagge). Kidneys pale, apparently fatty.

299. 1873. A woman, æt. 44, with family and personal history of rheumatic gout, was admitted with cerebral hæmorrhage. The cerebral vessels were bad—thick and opaque, with nodules of atheroma in them, so much so that the left middle cerebral was nearly occluded. Heart 14 oz., left ventricle considerably hypertrophied. Kidneys 14 oz., the left small and deeply puckered, with much dilated pelvis. The cortical structure was fair in quantity. The other organ was double the normal size and its structure healthy.

162. 1875. A man, æt. 56, a labourer, at work suddenly fell apoplectic. The cerebral vessels were atheromatous. The heart weighed 13 oz. and was healthy. The kidneys weighed 11 oz.; their vessels were rather thick, but they were good organs.

435. 1875. A man, æt. about 42, admitted with apoplexy. The vessels at the base of brain were rigid and thick, but not

definitely atheromatous. The heart weighed 14½ oz. The kidneys weighed 13 oz. and were quite healthy.

165. 1876. A man, æt. 41, with apoplexy. The vessels of the brain were exceedingly diseased. The heart weighed 13 oz., and the kidneys 9½ oz. Both heart and kidneys are described as healthy.

248. 1876. A woman, æt. 60, with recent and old apoplexy. The vessels at the base of the brain were uniformly thick and atheromatous. The heart weighed 14 oz., the kidneys also 14 oz., and were quite healthy.

378. 1877. Female, æt. 67. The chief arteries were thick throughout with a patchy distribution of atheroma. The heart weighed 11 oz. and was quite normal. The kidneys 8 oz., surfaces a little dimpled. Cortex looked very good; a small cyst here and there. I thought them capable organs.

21. 1878. Man, æt. 61. Vessels at base extremely diseased. Heart 13 oz. Left ventricle thick. Kidneys 13 oz., quite healthy.

230. 1878. A man, æt. 75. The cerebral vessels and all others very atheromatous. The heart weighed 13 oz. The left ventricle *not* hypertrophied. The kidneys were small, 8 oz. only, but quite good.

372. 1879. Male, æt. 55, admitted for apoplexy. There was general atheroma of the peripheral vessels. The heart weighed 22 oz., with marked hypertrophy and dilatation of the left ventricle. The kidneys weighed 15½ oz., contained a few cysts, but looked very good organs indeed.

124. 1880. A woman, æt. 60, admitted for hernia, dying from that cause. The heart was much hypertrophied, weighing 18½ oz., the left ventricle being extremely thick. The kidneys appeared healthy, but their arteries were thickened. The microscope showed that there was some degeneration of Malpighian tufts and perhaps a little excess of stroma in the kidneys, but their structure was practically healthy. The arterioles of the pia mater showed moderate thickening, chiefly of their muscular coat. Dr. Fagge adds, "I think this case is distinctly opposed to the view that cardiac hypertrophy is secondary to an advanced degree of kidney disease."

392. 1880. A man, æt. 53, admitted for apoplexy. There was general arterial disease, the vessels at the base of the brain

having a thick sodden appearance as if soaked in water. The heart weighed 12½ oz., the left ventricle being a little thick. The kidneys weighed 12 oz. The vessels were thick, but the cortex was smooth and looked quite healthy. There were one or two cysts.

309. 1881. A man, æt. 48, admitted comatose from cirrhosis. The vessels of the brain were opaque and sodden, and the membranes generally thick. No atheroma. Left ventricle a little thick. Kidneys large and coarse.

317. 1881. A man, æt. 50. The vessels looked sodden but were not atheromatous. The heart was normal, the kidneys were coarse and large.

313. 1882. A man, æt. 55, admitted with scalp wound, fractured ribs, and pneumonia. The vessels at the base of the brain were thick and sodden as in renal disease, but the kidneys were quite healthy; weight 12½ oz. The heart is not described.

365. 1882. A man, æt. 48, admitted with erysipelas of the scalp. The kidneys were quite healthy, 15 oz. Heart 11½ oz., healthy. Vessels at the base of the brain decidedly sodden-looking and thick.

Here, then, are 16 cases in which the kidneys are healthy but the arteries are bad, and the heart in many enlarged. But what strikes one perhaps most is the infrequency with which typical cases of the kind are to be met with. Many a case may be found in our records in which there is a general atheroma of the vessels without any notable hypertrophy of the heart. Even in these 16 cases several have a heart which is described as normal. And what are 10 or 16 cases in a period of ten years when in the same period the association of large heart and thick arteries *with* renal disease has been one of the commonest of the experiences in every year? I may add further that there is not a single case under forty years of age.

This association of morbid changes is one upon which many of the ablest minds of the day have expended their strength with the result that might have been expected. The subject has become obscured in a cloud of subtle reasoning. And it may well be doubted whether the ready-to-hand explanation of Bright's time, that the blood being altered in quality

becomes obstructed in its passage through the capillary system, and the heart and arteries, having more work to do, hypertrophy in consequence, has been in any material way added to or advanced upon. It is an obvious common sense explanation and is in accord with the elementary physiological principle that the tissues have the power of selection, in other words, of obstructing the circulation of fluids, the normal composition of which has become altered. And as regards the relation in time which the disease of the kidney bears to these arterial and cardiac changes, there can be no doubt that such cases as those recorded by Dr. Galabin, and largely supplemented in the present paper, strongly favour the view that a simple nephritis is a competent cause of these special morbid changes. It may indeed be said that, taken in conjunction with such other cases as granular kidney following scarlatina, granular kidney produced by lead-poisoning in young people, a very good example of which has lately been presented to the Guy's museum by Dr. Wilkin, of Beckenham, certain cases of injury to one kidney which has been followed by hypertrophy of the heart, and experimental results derived from the lower animals, the evidence on this head is conclusive.

As I have said elsewhere, I do not consider that this conclusion deals, as some might think, the death-blow to the theory of arterio-capillary fibrosis. "Arterio-capillary fibrosis" I regard rather as a not altogether successful attempt to ground a principle which has a very wide action in pathology, that living bodies decay by systems as much as by organs. There can be no doubt about it, and examples might be given from the nervous system, the circulatory system, the glandular system, the respiratory system (including the skin), and so on. Very early in the history of Bright's disease it was suggested that the blood was the primary seat of change. Finger, of Prague, in 1847,[1] writes that as in other blood diseases so also in Bright's disease, the *blood* is first diseased; and, like other dyscrasiæ, that in question may terminate fatally before it has occasioned the diseased product, *i. e.* the degeneration of the kidneys. Dr. Walshe two years later maintained much the

[1] 'Prag. Vierteljahrsch.' I am indebted to Sir W. Jenner for this reference, which is quoted in a review of the works of Frerichs, Rees, Gairdner, and Johnson in a number of the 'Brit. and For. Med.-Chir. Review' two or three years later.

same view. Sir William Gull and Dr. Sutton have of late years shifted this ground to that of questioning the staying power of the material which composes the vascular conduits. But I do not know that there is any necessary disagreement between the two hypotheses. Both attribute to a primary failure in a generally distributed material what is for the most part considered to be the result of a purely local disease. For myself I hold very strongly to a belief in primary generalised tissue changes, but in the particular instance in question the evidence seems to point equally strongly to the paramount influence of local disease.

But I must not pursue this subject; it is a very attractive one, and when pen is put to paper one seems to become the centre of a wheel, the spokes of which run out to a very distant tire, no matter which of very many the eye follows. My object, however, was simply to put on record the material which I had collected from our post-mortem records, and this, so far as it occurs to me, I have done.

ONE HUNDRED CASES

OF

CEREBRAL TUMOUR,

WITH REFERENCE TO

CAUSE, OPERATIVE TREATMENT, MODE OF DEATH, AND GENERAL SYMPTOMS.

By W. HALE WHITE, M.D.

The accompanying tables, containing 100 cases of tumour of the brain, have been collected from the post-mortem records of Guy's Hospital. Ninety-nine of these occurred during the thirteen years 1872-84, both inclusive; the number of autopsies was 5850, or about 450 a year, which gives one case of tumour of the brain to every 59·1 that come into the post-mortem theatre.

Of the 100 cases the growth was tubercular in 45, a glioma in 24, a sarcoma in 10, a carcinoma in 5, a glio-sarcoma in 2, a cyst in 4, a gumma in 5, a lymphoma in 1, a myxoma in 1, and doubtful in 3.

Let us first examine the cases of tubercle. Of these 34 were in the male sex and 11 in the female; thus it is seen that tubercle forms no exception to the rule that tumours of the brain are more common in the male than the female, and if the explanation of this fact be that men are much more liable to blows on the head than women, it would appear that in persons with a tubercular predisposition a blow on the head is very liable to set up a tubercular deposit in the brain. More

males than females are subject to phthisis, although the female population is in excess of the male, but with regard to this it must be remembered that males are much more liable to exposure to those trades that produce phthisis than females, so that the probability is that the cases of tubercular phthisis are not very much more common in men than in women; at any rate it is quite certain that they are not more common in the very high proportion of 34 to 11 which exists in tubercular masses in the brain. Hence in the case of the brain there is some additional cause for the male preponderance which does not exist in the case of the lungs; it may be that this cause is the liability to blows on the head, but, as will be shown directly, this is hardly likely. The average age of patients who die from cerebral tubercle is 12·45 years; the eldest in the series of 45 cases was fifty-eight, the youngest two years old. No fewer than 24, or more than half, were under ten years. Thus we see that tubercular disease of the brain is essentially a disease of childhood, and this fact tells very strongly against the usual view just mentioned that tumours of the brain are more common in the male sex than the female on account of the excessive liability of the former to injury, for it can hardly be supposed that male children under ten are more liable than female children to blows on the head. These figures are, I think, most important as pointing to the fact that we have by no means yet explained the cause of the predisposition of males to cerebral tumours.

The cerebrum was affected twenty-two times, the cerebellum twenty times, the pons six times, the crus once, and the medulla once; a few instances in which the tubercles were described as multiple are not here included. Considering the much smaller size of the cerebellum than the cerebrum we see that the former is affected much oftener than would be expected. This quite accords with the usual teaching, but these figures do not throw any light on the cause of this peculiarity. From the above we may learn that a cerebellar tumour in a child is almost certainly a tubercular mass.

The growth was multiple in 19 cases and single in 24; this shows very well the liability of tubercular masses to be multiple. We need not concern ourselves further with the multiple cases, but will turn to the single ones; of these the

cerebrum was affected thirteen times, the cerebellum ten times, the pons once, the crus once, and the medulla once; here the proclivity of the cerebellum is very evident. Sometimes the growth, although multiple, was confined to the cerebellum, so we find that whilst out of the single cases the mass was in the cerebellum alone ten times, out of all the 45 it was confined to the cerebellum fourteen times. Presuming therefore that an operation would be unjustifiable if the tubercular masses were multiple unless they were close together as they would be in the cerebellum, we see that the largest number of cases which, apart from all other considerations, it would be possible to operate upon are 26 single ones, together with 4 additional cases in which the growth, although multiple, was confined to the cerebellum. But of these 30 cases the great majority are unsuitable for operation for one or other or both of two reasons; in the first place the mass may be in some vital part, such as the medulla, or it may be quite inaccessible, as when it is at the base of the brain. A glance at the tables will show how frequently this alone will prevent operation, and the local symptoms pointing to the position of the lesion will in each case that may come under his notice determine the physician as to the advisability of operation. In the second place other organs in the body are usually affected; in all the 45 cases one or more other structures than the brain were affected. The average number of other organs affected was 3·61. One other organ was affected five times, two others four times, three others thirteen times, four others eleven times, five others seven times, six others four times, and seven others once. We may, I think, take it for granted that no one would like to operate on cases in which more than two other organs were diseased, and it will therefore be worth while to examine carefully the 9 cases in which only one or two other structures were affected. The cases are 383^{82}, 189^{80}, 278^{80}, 316^{80}, 429^{77}, 289^{76}, 339^{76}, 422^{74}, 258^{73}.

In 383^{82} there was a large mass in the right cerebellum with great ventricular distension. In 189^{80} there was a mass in the left lobe of the cerebellum. In 278^{80} there were multiple masses in the cerebellum and one in the left corpus striatum. In 316^{80} there was a large mass in the right half of the cerebellum. In 429^{77} there was tubercle of the cerebellum and pons. In 289^{76} there was a walnut-sized mass in the fissure of

Rolando. In 339[76] there was a mass in the left hemisphere close to the median fissure. In 422[74] there was a large tumour of the temporo-sphenoidal lobe. In 258[73] there was a walnut-sized mass in the centre of the cerebellum. Now, 278[80] certainly could not be operated upon as the masses were multiple and 429[77] could not because the pons was affected. That leaves 7 cases out of the 45 in which a question of operation might be considered, but I do not think many would be found bold enough to operate in all seven; it is a question for each surgeon to decide for himself. 258[73] would have been a very unfavorable case because of the existence of meningitis, and in 383[82], 316[80], 422[74] the mass was very large, so that if these 4 be excluded, we are reduced to 3 cases in which an operation would be feasible, and even in them it must be remembered that other organs were tuberculous. In favour of operating in the 4 just excluded it must be remembered that large pieces of brain have been often successfully removed and that meningitis is capable of recovery, although I must say I doubt whether portions of the brain can be removed with impunity or meningitis recover in persons already affected with tuberculosis; nor must it be forgotten that many of these patients have lardaceous disease. On the other hand, we must distinctly bear in mind that all the tables in this paper place the possibility of operating in too unfavorable a light, for the condition of the brain at death is by no means the condition when the first symptoms show themselves; and that the earlier an operation is performed the easier it will be, for the growth will not be so large, nor have infiltrated so much; hence it is very desirable that we should acquire great skill in diagnosing cases of cerebral tumour very early in their growth.

Among the 24 patients who had gliomata the average age was 32·4, the youngest being three years old and the eldest sixty-two. This average age hardly supports Virchow's suggestion that many gliomata are congenital. There were only 5 females to 19 males; of the 4 cases under twelve all were males, thus pointing to a male predisposition apart from any liability to injury. On looking through our post-mortem records it is quite evident that the word glioma has often been very loosely applied, and there can be no doubt but that some of the cases here described as gliomata are in reality

sarcomata; still that hardly affects the drift of this paper, the chief object of which is to find out how many tumours of the brain are amenable to surgical treatment. Now, of these so-called gliomata I find from the post-mortem reports that 11 are described as infiltrating, whilst it would appear that 10 were not infiltrating the surrounding substance, whilst in 3 it is impossible to give a definite statement. It is probably owing to the loose application of the word glioma that our records differ from those of Wernicke,[1] who states that gliomata are infiltrating tumours. The cerebrum was the seat of the disease in 13 cases, the cerebellum in 4, the pons in 2, the medulla in 1, the dura mater in 1 and the pituitary body in 3. Thus it will be noticed that the cerebellum does not here show the same predilection for growth as it did in the case of tubercle. Of the cases in which the pons was affected, one occurring in a boy aged three was an example of the gliomatous enlargement of the pons which is seen in children; in the other glioma of the pons the disease took place in a man aged forty, and the medulla was affected also.

In the 3 cases in which the pituitary body was affected it would have been very desirable to have a thorough microscopical examination, as also in the tumour of the dura mater, but as previously explained this group hardly pretends to histological accuracy.

Other parts of the body were affected in 4 cases, viz. there was basal meningitis in 2, there was a gliomatous tumour in the cord in 1, and the suprarenal was affected in 1. In 1 case there were multiple gliomata in the brain.

It is quite evident that the following cases are not suitable for operation: (1) those where the growth is at the base of the brain; (2) those in which it is infiltrating; (3) those in which there are growths elsewhere. Of the 10 which are described as being non-infiltrating the following 6 are free from these conditions: 36^{77}, 55^{78}, 50^{76}, 215^{79}, 123^{81}.

123^{81} was the size of a walnut on the under surface of the cerebellum resting on the medulla. 215^{79} was a round mass in the centre of the cerebellum, and easily shelled out; there was some thickening of the membranes at the base. 36^{77} was a round mass in the cerebellum. 50^{76} was a tumour

[1] Wernicke, 'Lehrbuch der Gehirnkrankheiten.'

the size of a small walnut in the frontal lobe. 55[75] was a globular growth springing from the dura mater and pressing into the cerebellum. It would, I think, be possible to operate upon all these, the only doubtful ones being 123[81], in which the tumour resting on the medulla would have made the operation difficult, and 215[79] in which there was some basal meningitis. In many of these cases the question of whether one should operate because of the presence of cerebral softening is open to debate but cannot at present be settled because we have no information as to the possibility of the recovery of cerebral softening when its cause is removed.

Of the 10 cases that are recorded as sarcomata the average age was thirty-seven years. One was a case of multiple sarcoma of the dura mater, cerebrum, and cerebellum. Four of them did not grow from the brain, and of these, 3 grew from the dura mater and 1 from the Gasserian ganglion; *à priori*, one would have thought that these would be extremely suitable cases for operation, but an examination of their details will show that they were all very unfavorable. Thus, 38[83], the case of sarcoma of the Gasserian ganglion, was quite unamenable to treatment, for the tumour was not only at the base of the brain but grew forward into the orbit; 57[77] was even in a worse place for operating, for it was growing from the dura mater over the basilar process, and not only so but there were many smaller tumours elsewhere in the dura mater; 476[75] also grew in a position which would have rendered operation very difficult, for it was attached at the junction of the falx cerebri and tentorium and lay on the corpus callosum; in the remaining cases of sarcoma of the dura mater the growths were multiple, and were also secondary to growths elsewhere in the body. From these facts we learn that sarcoma of the dura mater is especially unamenable to treatment, for in 2 out of 4 cases it was multiple and associated with other sarcomata elsewhere in the body; and in the other 2 cases it was situated in a place the position of which rendered its surgical treatment impossible. Hence, as out of a hundred cases of tumour of the brain only 4 were sarcomata of the dura mater, all of which were unamenable to treatment, we may conclude that this form of cerebral tumour is not of much surgical interest.

Let us now examine the 5 cases of sarcoma of the cerebrum

alone. 255[79] was a small growth with a cyst in the centre in the region of the fissure of Rolando, and apparently from the report it was infiltrating the brain-substance; not only so, but the dura mater over it was extensively diseased. Perhaps this latter fact would hardly affect the possibility of excising it, but I think that the fact that the surrounding cerebral tissue was infiltrated would prevent any success attending a surgical operation. 113[74] might very likely have been removed at an early date of growth, but at death it was very large, viz. two by two and a half inches. Hence any late operation would have been so extensive that its success would have been to say the least doubtful, and considering how difficult growths in the occipital region are to diagnose it is very unlikely that the position of the growth could have been made out early enough to make the operation an easy one. 140[72] infiltrated the surrounding brain-substance and was also situated rather deep under the cortex, so that for both these reasons there is but slight probability that operation would have done much good. 367[73] also infiltrated the cerebral substance in addition to having much cerebral softening around it, and exactly the same remarks apply to 117[84]. Thus, we see that of the 5 cases of sarcoma of the brain only 1 could have been removed with any prospect of success, and even then the operation must have been performed early. In 3 of the cases the surrounding brain was infiltrated and 2 of them had secondary growths elsewhere in the body. Among all the 10 cases the youngest was twenty and the eldest sixty.

There are 5 cases among the 100 which are returned as carcinoma; the youngest was twenty-three, the eldest sixty-one, the average age was 43·6. Three cases were multiple in the brain, and in the remaining 2 the growth was in the cerebrum. None of the growths are stated to have infiltrated the surrounding brain. In 1 the primary growth was in the mediastinal glands, in 1 it was in the rectum, in 2 in the liver or gall-bladder, and in the remaining case the vertebræ, ilium, liver, spleen, and lumbar glands were all affected. Considering that cancer of the brain is infinitely rare except when secondary to growth elsewhere it is obvious that surgical interference will never be needed. It may here be noted how the English teaching and experience differ from that of

Lebert, who thinks that in the majority of cases it is primary in the brain. Nor were either of the glio-sarcomata amenable to operative treatment, for one was multiple and accompanied by similar growth in the lung and the other could not have been reached because it was situated at the genu of the corpus callosum.

With regard to the gummata they of course are the most hopeful of tumours of the brain from the fact that there is distinct chance of benefiting them without any operation. Even if operative treatment in cerebral tumours were to become general it would only be by accident that a gumma would ever be operated upon, for directly the diagnosis was made of specific cerebral mischief one would put the patient upon large doses of iodide of potassium. Of the 5 cases 2 were multiple; in 1 the growth was in the medulla, in 1 it was in the cerebrum, and in 1 in the pons. In 2 cases no mention is made of any syphilis elsewhere, in 2 there was basal meningitis, and in the fifth there was a gumma of the spinal cord also.

There are 4 cases of cyst, and 1 of them is excessively rare, being an example of hydatid of the lung with hydatid of the brain. Had the hydatid of the lung been diagnosed during life and had the cerebral hydatid, instead of being in the temporo-sphenoidal lobe, been in a position which would have been easier of diagnosis, it would have been a very suitable case for operation, but hydatid of the brain is so very unusual that it need not be considered in the group of cerebral tumours. Of the remaining 3 cases, in 2 the cyst was in the cerebellum, which is to be noted as the most common position for a cerebral cyst, in fact Wernicke says that cysto-sarcoma of the cerebrum is unknown. The remaining case was one of cyst between the dura mater and the brain; this was accompanied by a cancer of the neck, so that here again operation would have been out of the question. Of the 2 cerebellar cysts 1, a most peculiar case, was accompanied by cysts in the pancreas and liver, but the other would have been an admirable case for operation because there were no growths elsewhere and no infiltration of the surrounding brain-substance. The conclusion then that we may come to is that out of the 4 cases of cyst of the brain probably not

more than one could have been operated upon, but that the hydatid might have been, if its nature had been found out during life. The myxoma was very small and but a very little way under the surface, and there is no reason whatever why it should not have been operated upon successfully if its position could have been diagnosed; but of this I have great doubt.

The lymphoma certainly could not have been operated upon, for the brain, dura mater, bronchial glands, and heart were all implicated.

The doubtful tumours are a small but decidedly hopeful group, for although 218[85] was so deeply situated as to be quite hopeless, 104[73] being a cyst in connection with a small cerebellar tumour, and being quite unconnected with the surrounding brain-substance and not accompanied by any growths elsewhere in the body, might easily have been removed; and the same reasoning will show that 215[72], a walnut-sized tumour in the right hemisphere, might also have been successfully operated upon.

There is one point in the above consideration of the possibility of operating upon cerebral tumours to which I have not paid much attention, namely, the very important one of the possibility of exactly locating their position. The reason why but little notice has been taken of this has been that many of these cases were reported before the importance of the exact localisation of function was appreciated, so that we are too often left in the dark upon the question as to whether the precise position of the growth was made out during life; still the best diagnosticians so frequently make mistakes that a certain number of cases which might in every respect be suitable for operation will be failures, because the position of the growth will not be correctly made out. We came to the conclusion that not more than 3 tuberculous cases were likely to be benefited by operation, that at the outside 6 and probably only 4 gliomata would be benefited; that only one of the 10 sarcomata could have been operated upon, and the chances of success here were small; that none of the carcinomata or glio-sarcomata were amenable to treatment, and that the gummata would be better treated by iodide of potassium. Of the 4 cases of cyst 1 could certainly have been operated upon and perhaps also another, the case of hydatid; the

myxoma was, and the lymphoma was not, amenable to this treatment, and of the 3 doubtful cases 2 could have been operated upon. Thus we see that out of 100 cases of tumour of the brain, 10 might certainly have been operated upon, and 4 additional ones might possibly have been, so that in 10 per cent. of our cases we can hold out some hope of operative relief to our patients, provided that a correct diagnosis of the position of the growth be made, even so late as shortly before their death, whilst of course earlier in their histories many others might have been operated upon with a good prospect of success.

In each of the 100 cases, I have read through the clinical report in order to discover, if possible, the cause of death. No doubt each case died from paralysis either of the respiratory or of the cardiac centre, unless indeed the termination happened to be brought about by disease of some distant organ; and even in that case it might take place from paralysis of one of these centres. It has been rather difficult, owing to the different wording of the reports in different cases, to draw up a definite table of the manner of death. In the first column I have placed all those cases in which the death was undoubtedly sudden, by which I mean that in all of them it took place within half an hour of a time at which an immediate end was not suspected; in many of them it took place in a few minutes. In the second column I have placed those in which it was gradual. Many of the deaths will not be found in either column, the reason being that it is not stated in the report to which class they belong. In the third column are placed those cases in which the patient is stated to have become unconscious or comatose and died, and in which there is nothing to show that he was asphyxiated, that is to say he had not the usual signs, such as lividity; whilst in the fourth column come the cases which terminated by asphyxia. In the next column will be found those cases in which the heart went on beating after the cessation of respiration, and in the last column will be seen a miscellaneous collection of modes of termination. It is especially to be noted that there is not a single case in which the heart ceased before the respiration stopped. The cases in which meningitis was present are not included, as the whole object of this paper

is to treat of tumours of the brain only. Several cases appear in more than one column, for a patient is often described thus: "He suddenly became blue in the face and comatose."

Sudden death.	Gradual death.	Coma.	Asphyxia.	Respiration stopped first.	Various.
127^{84}	356^{80}	117^{84}	358^{84}	96^{83},	38^{83}, delirium and dyspnœa.
358^{84}	123^{81}	358^{84}	123^{81}	5 m. before	374^{83}, fit, stertor.
96^{83}	410^{80}	96^{83}	278^{80}	heart	383^{33}, quietly.
374^{83}	19^{79}	133^{81}	316^{80}		18^{81}, convulsed.
123^{81}	97^{79}	356^{80}	255^{79}	123^{81}	328^{79}, delirious.
316^{80}	196^{79}	367^{79}	110^{78}	110^{78}	57^{77}, fit.
110^{78}	215^{79}	19^{79}	45^{78}	45^{78},	345^{76}, lung disease.
45^{78}	328^{79}	93^{79}	374^{74}	30 m. before	218^{85}, lung disease.
204^{77}	497^{77}	131^{79}	104^{73}	heart	211^{73}, respiratory paralysis.
186^{76}	109^{76}	57^{77}	6^{72}		215^{72}, respiratory paralysis.
74^{75}	375^{76}	302^{77}	211^{73}	$376\frac{1}{2}^{73}$	
$376\frac{1}{2}^{74}$	339^{76}	50^{76}	367^{73}		
104^{73}	137^{74}	375^{76}			
6^{72}	204^{74}	411^{76}			
	207^{73}	113^{74}			
	8^{72}	95^{73}			
	211^{73}	140^{72}, 111^{73} } Hæmorrhage from stomach.			
		367^{73}			
		8^{72}			

In regard to the first column its very existence is its peculiarity. The number of cases in which the mode of death is mentioned is as nearly as possible 50, and in 14 of them, or 28 per cent., it is distinctly stated that the death was sudden, and in all probability it was so in some others, so that if we say that from 30 to 40 per cent. of the cases of cerebral tumour die suddenly we shall probably be somewhere very near the mark. Most of the readers of this paper will be able to recall many instances. I can recollect two; in one of these, the patient, who had been helping the nurses in the ward in the daytime, went to bed, and was found dead in bed by the night nurse. A peculiarity about this mode of death is that very often it is brought on by a slight cause; thus on searching the records at Guy's I have met with one case in which the patient died suddenly after the act of micturition, another died suddenly on being turned over on her side by the nurse, and another after taking a dose of medicine; and one or two striking examples will be found in the 'Principles and Practice of Medicine,' by the late Dr. Fagge. In none of the

14 cases did the respiration go on after the heart had stopped, thus bearing out Dr. Fagge's remarks on the subject, but in 5 of them the heart continued to beat after the respiration had stopped, and probably in many more had an accurate observation been made; in one case it went on beating for half an hour. In 2 others death is said to have taken place from asphyxia; so that in 7 out of the 14 we have direct evidence that death took place from an affection of the respiratory centre and in the remaining 7 there is no evidence that it did not do so.

The three points to which I would particularly draw attention are, firstly, that the death, as far as can be made out, never takes place from an implication of the cardiac centre; secondly, that it is often sudden; and thirdly, the frequent absence of asphyxia. We can suppose two ways in which the respiratory centre may be affected, either by the increased intracranial pressure, or by a peripheral stimulation, which in this case would be the cerebral tumour, in the same way as we see the cardiac centre affected by a blow on the abdomen. But neither of these hypotheses explain why it is that the respiratory is affected and not the cardiac; all we can say is that for some reason or another the cardiac centre is less irritable than the respiratory. It is just possible that the explanation of this is anatomical, the cardiac being in such a position that it is less likely to feel the effects of pressure.

In most of the other examples of sudden death we are able to say why the death should be sudden: thus in aortic regurgitant disease some exertion allows of the flow of so much blood back into the ventricle that the patient dies instantly, the brain being completely anæmic; or with the sudden blockage of the pulmonary artery it would be remarkable if we did not have sudden death, and so in other instances; but with the tumour of the brain there is no sudden increase of size. The other symptoms indicative of pressure do not come on suddenly, such, for example, as ventricular distension; *à priori* we should expect that the gradual increase of pressure which takes place would, if it affected the respiratory centre, lead to a gradual asphyxia, but in 14 of our cases the death was sudden. The only direction in which we can, I think, look for an explanation, is that the death was in 3

cases at least brought about by some movement, once by being turned over by the nurse, and once by the act of taking medicine. Now, a little consideration of the disposition of the membranes of the brain, more especially the processes of the dura mater, will show how very unevenly the increased intracranial pressure must be distributed, so that it is quite possible that in several patients suffering from a cerebral tumour the increased pressure, although extreme, shall be for some time not so distributed as to affect the respiratory centre, but that some movement of the body shall so alter the direction of the pressure that its effect shall be immediately felt upon the respiratory centre and hence cause sudden death. It has been suggested that the roots of the vagus are the parts pressed upon, but were this so we should expect death to take place by the heart and not by the lungs. The third peculiarity about some of the sudden deaths, namely, the absence of any lividity or other usual sign of death by failure of respiration, is very difficult of comprehension, in fact, I am afraid I must leave the question in the same position as Dr. Fagge, who, in speaking of such cases, said he could not understand them.

With regard to the position of the growth I should like to draw attention to the fact which will be noted on running one's eye over the appended tables, namely, that of the patients who died suddenly, in 6 the growth was in the cerebellum, in 2 it was in the medulla, and in 1 it was in the pons only. Thus in 9 out of the 14 cases it was situated near the medulla, so that not only may the sudden death be due to a sudden increase of the general pressure brought to bear upon the growth, but some movement, such as turning in bed, &c., may so increase the local pressure on the medulla by the growth itself as to lead to sudden death.

On reference to the second column it will be seen that in 17 cases the death was gradual, so that among the 31 cases in which the rapidity of death is definitely stated the numbers are pretty equally divided, but I suspect that the sudden deaths are not quite so numerous in proportion to the gradual as this would seem to show, for the sudden termination, being the more striking, is more likely to be noted. In most cases there was nothing to show the exact mode of death of those patients who died gradually, but con-

sidering that among all our cases we have no evidence to show that death ever took place by the heart we may conclude that probably in those cases it took place by a slow compression of the respiratory centre.

In 20 cases the patient became comatose before death; this, I think, accords with general experience. Coma cannot in any way be looked upon as the cause of death, which must take place either by failure of cardiac power or failure of respiration; all it shows is that in many cases the increased pressure is sufficient to render the patient unconscious. The difficulty of correctly understanding the next two groups has already been alluded to, and it has been stated that at present no explanation has been offered of the fact that some of those who die by failure of respiration die with the ordinary signs of asphyxia, whilst some present no such features. So far as these tables go it would seem that 12 have the symptoms of asphyxia for 5 that have not. Perhaps the fact that the heart continues to beat so long after respiration has stopped may be shown at some future time to be of use in explaining the difficulty.

The last column contains the cases which from the wording of the report it is impossible to place in any of the foregoing groups. Two died from tubercular affection of the lungs; it is almost certain that the one that is mentioned as dying of dyspnœa and the two that are said to have died from respiratory paralysis ought to be classed either with the cases of asphyxia or with those in which respiration stopped before the heart. Two were delirious and two were stated to have had fits; it will be noticed how rare these conditions are as precursors of death in comparison with coma, but they are probably due to the same cause, namely, the increased intracranial pressure.

The statistics show that vomiting took place in 29 cases, and as far as I could gather it was absent in 28, but these results must be taken with reservation, for in an imperfectly made report an account of vomiting is very likely to be omitted. Still we may safely use those examples in which it was present to discover what position of tumour is most frequently associated with this symptom, and among the 29 cases the cerebellum was affected in 14, the pons in 2, the medulla in 1, one of the hemispheres in 10, and the growth

was multiple in 2 cases. These figures fully bear out the common statement that vomiting is more usual in cerebellar tumours than in any other form. The cerebellar growths probably act by their direct pressure on the vomiting centre. It will be seen that three others, viz. one in the medulla and two in the pons, were near it, and with regard to the two that are described as multiple it is almost certain that some of the growths were near it also; thus of the 29, the tumour was near the vomiting centre in 19. Of the remaining 9, it was so large in 6 that the medulla might easily have been affected by pressure. It would seem therefore that of all the numerous and important centres in the medulla those most easily affected by pressure are those for respiration and vomiting, some such as the glycosuric being very rarely affected, then probably only when the growth presses directly on the medulla or invades it.

In 36 cases there is a note of an ophthalmoscopic examination, and in only 6 is it definitely stated that there was no optic neuritis. Now, if we bear in mind that sometimes there may have been an error of observation, and also that sometimes only one examination was made, we shall see that it is extremely likely that in none of the cases was optic neuritis absent up till death. We may conclude, therefore, that in cerebral tumours optic neuritis is rarely, if ever, absent. These tables do not help us at all to determine the cause of optic neuritis, for they show that it will be present with any tumour in any situation.

In 60 cases the report has been sufficiently full for one to state something about headache; in 13 of these it was absent, and the average size of the tumours in the 13 cases is certainly less than the average size in the remaining 47. In not one of these 47 is it stated to have been at the vertex. In 15 it is said to have been frontal, but in only one of these was the growth distinctly in the frontal lobe; in the remainder it was in the most various positions, sometimes the base of the brain, sometimes the cerebellum. In 5 cases the pain was occipital; in 3 of these the growth was in the cerebellum, in one in the temporo-sphenoidal lobe, and only in one was it not in the posterior part of the brain; so that all we can say as regards the position of the headache is

that a pain in the occiput is suggestive of cerebellar tumour, although it is only in a few of them that the pain is thus localised. In a large number of cases there is only the statement that headache was present, or it is distinctly stated that it was general. There is one remarkable point, namely, that there is not a single instance of pain referred to the peripheral distribution of any of the sensory nerves (such as the fifth) which come off within the skull, although of course paralysis of the motor nerves is frequent enough. It may be observed that peripheral pain is also absent in meningitis. Probably the explanation lies in the fact that the pressure is gradually applied. The conclusion that we may come to with regard to headache is, I think, that it is in all probability a pressure symptom depending upon general pressure of the nerves in the dura mater, for we have seen that as a rule it bears no relation to the position of the growth, and that it is most likely to be absent in the smaller tumours. The fact that it is occipital in cerebellar tumour is a true case of an exception proving the rule, for the cerebellum is confined within a little skull of its own by the presence of the tentorium, and therefore the pressure pain is felt on the dura mater forming the boundaries of this little cavity; hence the pain is occipital.

The last general symptom to which my cases direct attention is slowness of the pulse; in nearly all the cases I have collected, the state of the pulse is recorded, although in very few of them is it mentioned frequently enough to be sure that it was never slow. Still, even bearing this in mind, I am very surprised at the infrequency with which any slowness is mentioned. Once it is mentioned as being 52, once 54, once 57, once 60, once 66, but in most of these cases it was only slow for part of the time, but often even when not slow, the report says it was irregular; so that the analysis of these cases would show that slowness of pulse is not a frequent feature of cerebral tumours, but irregularity is the more common abnormality.

In the following tables the numbers in the first column refer to the number of the autopsy in the pathological records of Guy's Hospital.

No. of P.M.	Sex and age.	Position.	Nature.	Infiltrating.	Other parts affected.	Mode of death.	Vomiting.	Optic nerve affected.	Headache.	Slow pulse.
1885										
218	F. 60	Large mass, not reaching surface, occupying right optic thalamus, lenticular nucleus, capsules, and claustrum	Doubtful	No	None	Lungs: bronchitis	Slight	—	Slight	No.
1884										
127	M. 27	Size of tangerine orange in left cerebellum at under and inner part, pushed medulla to right; lateral and 3rd ventricles dilated	Simple cyst, clear fluid, smooth lining memb.	No	Simple cysts, pancreas and kidney	Sudden; was found dead in bed	Yes	Yes	Yes	—
117	M. 31	Left frontal lobe destroyed, implicated 1st, 2nd, and 3rd frontal convolutions. On inner surface projected through grey matter to implicate right lobe, projected into ventricle, did not destroy its wall. On outer side and base did not reach grey matter	Round-celled sarcoma, with much hæmorrhage	Yes	Little nodules of growth, middle fossa of skull	Quiet coma	No	Yes	Yes	No.
318	M. 13	Pituitary body	Glioma (?)	No	Basal meningitis; no tubercle	—	—	—	—	—
358	M. 16	Right parietal and occipital lobes; all convolutions, especially right, much flattened	Glioma, with two ounces of brownish green fluid in it	Yes	None	Suddenly became comatose, blue in the face, and died in a few minutes	Yes	Yes	Frontal	—

No. of P.M.	Sex and age.	Position.	Nature.	Infiltrating.	Other parts affected.	Mode of death.	Vomiting.	Optic nerve affected.	Headache.	Slow pulse.
1883										
38	M. 47	Left Gasserian ganglion; anterior extremity of left temporo-sphenoidal lobe connected by means of dura mater, with small growth in orbit	Sarcoma	No	None (aortic disease)	Became delirious, suffered from great dyspnœa, then died	—	—	Yes	—
96	M. 11	Size of chestnut under surface of cerebellum, middle line, on 4th ventricle; lateral and 4th ventricles dilated	Glioma	Yes	None	Suddenly became unconscious, respiration failed, and 5 minutes later the heart stopped	Yes	Yes	Frontal	—
255	M. 11	Wedge-shaped, base at the cortex, apex at the central ganglia, left side	„	Yes	Spinal cord at 6th and 7th cervical nerves	—	—	Yes	—	—
374	M. 23	Pituitary body; from olfactory lobes back to pons and outwards to apices of temporo-sphenoidal lobes; much fluid in tumour	„	No	None (the stretched nerves were much softened)	Had a fit, became stertorous, and died	—	Yes	Frontal	—
400	M. 25	1st and 2nd right frontal convolutions and upper part of ascending parietal; inwards to central ganglia	„ (?)	Not stated	Chronic basal meningitis	—	—	—	—	—
427	M. 23	Just under left superior parietal and 1st occipital convolutions. Cystic	Carcinoma	No	Mediastinal glands	Any cerebral symptoms were quite masked by those due to disease of the lungs.				
87	F. 16	Considerable masses in both lobes of cerebellum	Tubercle	—	Lungs, intestine, kidney, meninges	—	—	—	—	—
203	M. 6	Small mass in right lobe of cerebellum	„	—	Lungs, liver, spleen, kidney, intestine, meninges	—	—	—	—	—

	12	over to left thalamus			teric glands, meninges					
1882										
116	F. 2	On surface, masses at right 2nd frontal, right angular gyrus, and left anterior parietal	„	—	Lung, liver, spleen, trachea, intestine, kidney, and convexity of meninges	—	—	—	—	—
383	M. 3	Large mass in right cerebellum, great ventricular distension	„	—	Mediastinal and mesenteric glands	Quietly	Yes	No	Yes	No.
1881										
10	M. 2	One mass in anterior end of corpus callosum, several in the cerebellum	„	—	Lungs, mediastinum, liver, kidneys, spleen, meninges	—	—	—	—	—
18	F. 4	One mass in right hemisphere, just above corpus callosum	„	—	Mediastinal and mesenteric glands, Fallopian tubes, lungs, liver	In convulsions	Yes	Yes	Yes	—
36	M. 5	Two small masses in cerebellum	„	—	Meninges, bronchial glands, liver, lung, kidney, spleen	—	—	—	—	—
112	M. 26	Single mass size of large pea, on under surface left temporo-sphenoidal lobe	„	—	Lungs, liver, peritoneum, glands of mediastinum, neck, and mesentery	No report	—	—	—	—
156	M. 3	Mass, half inch square, over left motor region	„	—	Pleura, intestines, mediastinal glands	Any cerebral symptoms completely masked by abdominal.				
22	M. 7	Masses in left island of Reil, left occipital region, and on right facial nerve	„	—	Pericardium, lungs, mediastinum	—	Yes	Yes	Frontal left sided	—
123	F. 22	Size of walnut under surface of cerebellum resting on medulla, rather to left of middle line	Glioma	No	None	Suddenly; became blue, respiration stopped before heart	Yes	No	Occipital	—
133	F. 35	Left temporo-sphenoidal lobe, extending to wall of lateral ventricle	„	Yes	Suprarenal contained growth, Virchow's struma suprarenale	Gradual; a long drowsiness deepened into coma	—	Yes	„	—

No. of P.M.	Sex and age.	Position.	Nature.	Infiltrating.	Other parts affected.	Mode of death.	Vomiting.	Optic nerve affected.	Headache.	Slow pulse.
1880										
356	M. 57	3rd right frontal convolution, 1 in. in diameter, extending into the lenticular nucleus	Glioma	No	None	State of unconsciousness for 2 days	Once	—	No	No.
410	M. 6	Whole left lobe of cerebellum	Tubercle	—	Pleura, lung, mediastinal glands	Gradually sank	No	?	No	No.
14	F. 22	Mass between right optic thalamus and lenticular nucleus	„	—	Lung, kidney, bladder	The lung symptoms completely masked the cerebral.				
178	M. 4	Multiple yellow tubercles of brain	„	—	Spine, liver, knee, meninges	—	Yes	Yes	Yes	No.
189	M. 4	Mass in left lobe of cerebellum	„	—	Mediastinal glands	—	Yes	Yes	Yes	No.
207	M. 52	Small mass in pons and in occipital convolutions	„	—	Lungs, suprarenals, kidney, testis, ureter	The general symptoms obscured any cerebral.				
253	M. 11	Mass in left corpus striatum	„	—	Lungs, bronchial glands, peritoneum, spleen	—	No	Yes	Frontal	—
278	M. 8	Multiple masses in cerebellum, and one in left corpus striatum	„	—	Hip	Asphyxia	Yes	—	Yes	—
316	F. 7	Large mass in right half of cerebellum	„	—	Mediastinum, liver	Shortly before death had attacks of lividity	Yes	Yes	Frontal	No.
1879										
367	M. 7	Mass of tubercle in left angular gyrus, and also in cerebellum	„	—	Elbow, lung, mesentery	Coma	No	No	No	No.
19	M. 13	Masses in right side of cerebrum near middle line, on ascend ing frontal convolution	„	—	Lung, mesentery, intestine	Gradually became drowsy	No	?	Slight	No.

93	M. 42	Multiple small masses in sulci, and cerebellum, thalamus, and pons	„	—	Cord, kidney, lung	Was comatose for some days	Yes	—	Yes	No.
231	M. 3½	A mass in left gyrus fornicatus	„	—	Meninges, lung, mesentery	—	—	—	—	—
59	M. 3	Infiltration of pons	Glioma	Yes	None	—	Yes	—	—	No.
131	F. 54	Cyst 1 inch in diameter in posterior part of right occipital lobe; also similar one in right half of cerebellum; soft, fleshy, viscid yellow contents	Glio-sarcoma	No	Similar growth affecting left lung	Coma	No	—	No	No.
196	F. 62	Right frontal lobe cyst 1½ × 2 inches, viscid yellow fluid	Glioma	Yes	None	Gradual	No	—	Frontal	No.
215	F. 23	Round mass easily shelled out of central part of cerebellum, 1 inch in diameter	Glioma (?)	No	Thickening of membranes at base	Gradual	Yes	Yes	Frontal and occipital	No.
224	M. 48	Greyish, soft, ½ inch in diameter, under left 1st and 2nd frontal convolution	Glioma (?)	Yes	None	—	No	—	No	No.
242	M. 44	The whole left hemisphere a yellow mass	Tubercle	—	Lungs	—	Yes	Yes	General	No.
255	F. 35	Small cyst in fissure of Rolando	Sarcoma	Yes	Considerable growth in dura mater over cyst	Asphyxia (?)	Yes	—	Frontal	No.
328	M. 55	Round tumour 2 inches across, firm, in left corona radiata, smaller one in right occipital convolution	Cancer	No	Lungs, liver, kidneys (much cerebral softening)	Became delirious and sank	No	—	No	No.
497	F. 61	Posterior part right 1st frontal convolution, size of greengage; one, size of an acorn, in right cerebellum, and one growing from tentorium	Cylindrical epithelioma	No	Rectum	Gradual	Yes	—	No	No.

No. of P.M.	Sex and age.	Position.	Nature.	Infiltrating.	Other parts affected.	Mode of death.	Vomiting.	Optic nerve affected.	Headache.	Slow pulse.
1878										
110	F. 9	Orange-size single cyst in right temporo-sphenoidal lobe	Hydatid	No	Lung	Attacks of shivering; directly after, eyes prominent, face red blotches. Heart rapid, tumultuous. Breathing long intervals, which became longer till death. Heart continued 3 min. after respiration ceased	No	No	General	No.
190	F. 36	Left cerebrum between optic thalamus, corpus striatum, and island of Reil	Glioma	No	None	—	No	—	No	No.
45	M. 40	Diffuse of pons and medulla	„	Yes	None	Breathing suddenly ceased. Heart continued ½ hour	No	—	No	No.
91	M. 3¼	Multiple small masses	Tubercle	—	Meninges, cord, lungs, spleen, liver, mediastinum	—	—	—	—	—
1877										
229	M. 3	Large mass under surface of left lobe of cerebellum	„	—	Meninges, elbow, thumb	—	—	—	—	—
429	M. 5	Right cerebellum and pons	„	—	Left suprarenal	—	Yes	Yes	Frontal	No.
36	M. 47	Hard round, left of middle line in cerebellum, centre soft from old hæmorrhage	Glioma	No	None	The pyæmia for which he was admitted masked any cerebral symptoms.				
57	F.	Growing from dura mater	Sarcoma	No	Many other tumours	Fits, unconscious,	Yes	Yes	Frontal	No.

	45	diamond-shaped space into 3rd and lateral ventricles								
1876										
50	M. 42	Small walnut in right frontal lobe	„	No	Yellow softening of brain around	Unconscious for several days	No	—	General	No.
186	F. 25	Pons	Gumma	No	Cord, surrounding cerebral softening	Was being turned over; died suddenly	No	—	No	No.
225	M. 25	Right superior and middle frontal	Glioma	Yes	None	Brought to the hospital in a fit, in which he died.				
375	F. 37	Walnut size, hard grey, of left middle lobe	Scirrhus	No	Breast, liver, surrounding cerebral softening	Coma lasting some time	Yes	Yes	—	—
411	M. 40	Right inferior parietal lobe $1 \times 1\frac{1}{2}$ inch, easily shelled out; similar smaller tumours posterior part of each 1st frontal	Glioma	No	Surrounding cerebral softening	Became unconscious; breathed stertorously	Yes	Yes	Frontal	On the whole slow, lowest 52.
61	F. 19	Mass temporo-sphenoidal lobe	Tubercle	—	Meninges, Fallop. tubes, liver, spleen, lungs	—	—	—	—	—
109	M. 9	Two small masses in right cerebellum	„	—	Mesenteric and cervical glands, intestines, lungs	Gradual	No	—	Yes	No.
161	M. 18	Mass in crus	„	—	Meninges, cord, lungs, prostate	—	—	—	—	—
164	M. 36	Small mass in left corpus dentatum in medulla	„	—	Lungs, liver, kidney, intestine	No cerebral, only lung symptoms.				
174	M. 10	Small masses in cerebrum, large in pons	„	—	Meninges, lung, spleen, liver	—	—	—	—	—
202	M. 11	Large mass in right lobe of cerebellum	„	—	Meninges, lungs, intestine, mediastinum	—	—	—	—	—
217	M. 7	Medium-sized mass under surface of left cerebellum	„	—	Meninges, cord, lung, spleen, mediastinum	—	—	—	—	—
289	M. 11	Walnut-sized in left fissure of Rolando	„	—	Lungs, intestine	—	No	—	Yes	No.

No. of P.M.	Sex and age.	Position.	Nature.	Infiltrating.	Other parts affected.	Mode of death.	Vomiting.	Optic nerve affected.	Headache.	Slow pulse.
339	F. 15	Left hemisphere close to longitudinal fissure	Tubercle	—	Peritoneum, Fallopian tubes	Gradual	Yes	—	Yes	No.
345	M. 9	Upper part of right fissure of Rolando; small mass	„	—	Lungs, liver, hip, kidneys, mediastinum	Lungs	No	—	No	No.
1875										
55	M. 5	Globular tumour, 2½ × 2 in., growing from dura mater, and pressing into cerebellum	Glioma	No	None	—	Yes	Yes	General	—
74	M. 32	Small millet-seed growth, left side, 4th ventricle, upper cornu	Gumma (?)	No	None	Sudden (20 minutes); congestion of face	Yes	—	Severe, both temples	No.
388	M. 56	Outside and behind right thalamus	Glioma	Yes	None	—	No	—	No	66.
440	F. 38	Small multiple tumours, for the most part affecting nerves at their exit	Gumma	No	Basal meningitis, larynx	—	—	—	—	—
476	M. 29	Tumour, 2½ × 1½ in., grew from junction of falx and tentorium, lay on corpus callosum	Spindle-celled sarcoma	No	None (bad cardiac)	No cerebral symptoms (died of aneurysm).				
1874										
113	F. 20	2½ × 2 in., posterior part of hemisphere; surface not implicated; shelled out	„	No	None	Lay insensible for days	No	Yes	General	No.
163	M. 40	Multiple soft growths grew from the dura mater, and	Sarcoma	No	Mediastinum, lung	The general symptoms completely masked any cerebral.				

218	M. 77	3 × 2 in.; a cyst under dura mater grew into brain, forming a cup-like depression over nearly all right frontal lobe	Cyst	No	Cancer of neck	—	—	—	—	—
376½	F. 22	In centre of cerebellum cyst containing 2 oz. of clear fluid; medulla much pressed	„	No	None	Sudden, breathing, ceasing before heart	Extreme	Yes	Extreme, general	No.
422	F. 45	Large tumour in temporo-sphenoidal lobe	Tubercle (?)	—	Lungs	Report imperfect	—	—	—	—
115	F. 21	Minute yellow masses on surface of cerebellum	Tubercle	—	Meninges, cord, lungs, kidney	—	—	—	—	—
137	M. 16	Large mass in left half of pons and two in cerebellum	„	—	Lungs, mesentery, suprarenal, intestine	Gradual, quiet	Yes	Yes	No	No.
142	M. 11	Small masses on vertex and also scattered through white matter	„	—	Lung, kidney, liver	No symptoms during life referable to brain.				
1873										
258	M. 7	Walnut sized in centre of cerebellum	„	—	Meningitis (none elsewhere)	No report	—	—	—	—
95	M. 40	Ill-defined soft growth in lower part of middle of left side of brain	Glioma	Yes	None	Comatose for 20 hours	No	No	Frontal	57 (during coma)
104	M. 25	Cyst size of pigeon's egg in left lobe cerebellum; clear yellow fluid, distinct lining membrane; near it a tumour size of filbert	Doubtful	No	None	Rather sudden, asphyxia	Yes	Yes	Occipital and frontal	No.
120	M. 42	Walnut sized, grew from tentorium; shelled away from brain; tumour in brain to inner side of left posterior cornu	Lymphoma	Yes	Bronchial glands, heart	The chest symptoms masked any cerebral.				

No. of P.M.	Sex and age.	Position.	Nature.	Infiltrating.	Other parts affected.	Mode of death.	Vomiting.	Optic nerve affected.	Headache.	Slow pulse.
207	F. 26	Two tumours growing from the dura mater, one 2 inches in diameter, the other smaller, both growing over cerebellum	Sarcoma	No	Rib	Gradually sank	No	Yes	Frontal	No.
211	M. 53	Large mass in the left parietal and front part of occipital lobes, extending forwards to corpus striatum, not affecting surface	Glioma	No	None	Coma and asphyxia lasting for days	No	—	General, vertex, frontal	No.
367	M. 60	Tumour in anterior part of right hemisphere in its substance	Spindle-celled sarcoma	Yes	None (much cerebral softening)	Coma and respiratory paralysis (not sudden)	No	—	Occipital	54—66
1872										
340	M. 48	Outer part of thalamus between it and Sylvian fissure, size of marble	Sarcoma	Yes	None, save small growth in pericranium	Became comatose; died quietly, hæmorrhage	No	Yes	Yes	No.
215	F. 30	In right hemisphere a mass size of walnut came to surface; dura mater adherent	Doubtful	No	None surrounding cerebral softening	Respiratory paralysis	—	—	—	60, irregular
111	F. 54	Just internal to centre of marginal convolution; size of hazel nut	Myxoma	No	None	Coma (hæmorrhage)	Yes	—	Yes	No.
8	M. 41	In parietal and occipital lobes; came to surface; shelled out easily	Gumma	No	None	Gradual	—	—	Yes	—
6	F. 26	Mass size of chestnut just behind island of Reil	„	No	Thickening of membranes; much cerebral softening	Sudden, taking place in 30 minutes from respiratory paralysis	No	Slight	Left side only	140 just before death

A NEEDLEWOMAN'S BURSA OF THE SECOND FINGER OF THE LEFT HAND.

By R. CLEMENT LUCAS, B.S.

It is reasonable to conjecture that with the development of new employments, which are being constantly multiplied by the growth of civilisation, new diseases may take origin or new phases may be impressed upon the outline of what is old. It is fair to suppose, on the other hand, that modifications in the mode of living and the cessation of certain industries may cause corresponding disorders to be lessened in frequency, or even to be ultimately effaced. In the latter category I am inclined to place the small but troublesome and painful affection which is the subject of this note. It is because I have not seen it described that I put it on record; but possibly at some previous time it was so frequent as to be thought unworthy of mention, whilst in the future it may become extinct, and the case I am depicting may be one of the last relics of a former civilisation. The introduction of sewing-machines must at any rate have lessened its frequency, and that it is now exceedingly rare I have good reason to believe.

When Hood caught the sympathies of a nation by vividly

depicting in his "Song of a Shirt," the terrible poverty and misery of a sempstress's life as she stitched and stitched:

> "With fingers weary and worn,
> With eyelids heavy and red,"

he probably had no clear conception of what the "worn" fingers implied, if regarded from a pathological point of view. One at least of the small infirmities induced by overwork, and directly occasioned by the kind of work which poor needlewomen perform, this paper will bring to light. The painful history of the infirm old woman who furnishes the subject of this memoir, is possibly more horribly real than any which moved Hood's tender heart and facile pen.

A poor, decrepid, old widow-woman, M. L—, 78 years of age, presented herself among my out-patients on Thursday, September 11th, 1884. She came complaining that a swelling on the end of the second finger of her left hand, which had been gradually increasing for some years, now gave her so much pain and inconvenience as to interfere seriously with her work. She told us that her average earnings amounted to not more than three shillings a week, on which sum she found it possible to live without entering the workhouse. Her work was shirt-making and sewing of the coarser linens and calicoes.

The second finger of her left hand was occupied on the palmar aspect of the terminal phalanx by a rounded fluctuating swelling, which is depicted in profile, Plate III, fig. 2. The swelling was somewhat tender on firm pressure, but not inflamed on the surface. It was diagnosed as a subcutaneous bursa. The interest in the case rested chiefly upon the manner in which this abnormal bursa was developed, and Fig. 1 is intended to show the position of the patient's hand when holding her work in sewing. It will be found that with the linen stretched over the left forefinger for the purpose of stitching, the whole weight of the fabric falls on the projecting end of the second finger. Long years of such pressure had resulted in the development of this bursa, how many and with what little interval of rest the freedom which ordinary workers enjoy may offer some indication. The tumour was tapped with a trocar and

cannula and about a drachm of clear, viscid, white-of-egg-like fluid was withdrawn. After the tapping the swelling of the end of the finger shrank into wrinkles of skin. The end of the finger was afterwards strapped and bandaged. Whilst she was under observation no return of the swelling occurred, but as, with her, attendance at the hospital involved a "walk which cost a meal," I do not feel confident that she would have attended again if my first treatment had proved unsuccessful. The object of this paper is, however, to point out a malady, not to advocate a treatment, which would not differ from that of bursæ in other parts of the body.

DESCRIPTION OF PLATE III,

Illustrating Mr. Clement Lucas's Case of Needlewoman's Bursa of the Finger.

Fig. 1. Hand showing the position when at work. A. The bursa at the end of the second finger.

Fig. 2. Side-view of the second finger showing the rounded enlargement caused by the bursa.

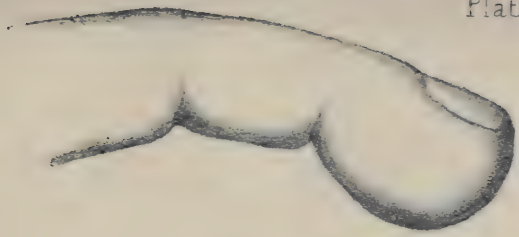


Fig. 2



Fig. 1.

ON

MIDDLE MENINGEAL HÆMORRHAGE.

By W. H. A. JACOBSON.

The writer trusts that a paper on the above subject will be thought not unsuited to these 'Reports,' on account of its importance; from the fact that it was in these 'Reports' that Mr. Cock published, forty-three years ago,[1] one of the few successful cases which are on record; and that, however far from exhaustive this paper may be, Hospital Reports would seem a fitting place for a collection of cases of an injury which while occurring in all ranks of life, must chiefly be met with, and if obscure, be elucidated from hospital practice.

While the importance[2] of the subject is shown abundantly by the frequency with which it is overlooked, the apparent slightness of the violence which sometimes precedes so fatal an accident, and the rapidity and suddenness with which death often supervenes, the writer ventures to consider the usual text-book teaching insufficient and misleading, for the following reason especially. According to many of these the symptoms of compression of the brain by middle meningeal extravasation are clear and definite, and the diagnosis easy.

[1] 'Guy's Hosp. Rep.,' 1842, vol. vii, p. 157. The sequel is in the vol. for 1857, p. 364.

[2] "Injuries of the head affecting the brain are difficult of distinction, doubtful in their character, treacherous in their course, and for the most part fatal in their results."—Guthrie, 'Injuries of the Head,' p. 1.

If such compression of the brain occurred by itself the diagnosis might be a simple matter, but a large number of the following cases show that the same violence which causes the extravasation often brings on a severe and fatal concussion, or grave laceration and contusion of the brain, and that thus when a surgeon has to treat a case of meningeal extravasation the symptoms of concussion (from which the patient may have never rallied) may be blended with and obscure those of the compression for which he anxiously examines; or he may be called to the case a little later on, and find the compression symptoms masked or obscured by those of injury to the brain.

In another point many of the books seem to mislead the student, *i. e.* when they urge trephining as if certain to be successful if it only be performed early. While it is most right and necessary, especially in these days when antiseptic surgery has made trephining so much safer, to give the patient every chance this operation may offer, it must always be remembered, what too many of these cases prove, that however carefully and early this operation be performed, and however thoroughly the compression be relieved, all may be rendered of no avail owing to concussion, contusion, or laceration of the brain bringing about a fatal issue.

The writer's thanks are due to his colleagues, past as well as present, for leave to make use of their cases, and to others also, and amongst them Mr. Hutchinson, Sir J. Fayrer, Mr. Beck, Mr. Godlee, Mr. Plimmer, Dr. Watson.

The article has been arranged under the following heads:

Some points in the anatomy of the middle meningeal artery; those parts of the skull with which it is in contact, and the brain which lies subjacent to this region.

The condition of things which is liable to be met with in the parts which are concerned in middle meningeal hæmorrhage, viz:

a. The condition of the skull.

β. The condition of the brain.

γ. The condition of the middle meningeal artery. The site of the lesion in it. Amount and condition of the clot, &c.

Classification and grouping of cases of middle meningeal hæmorrhage, according to their hopefulness for trephining, into three groups, A, B, and C, viz.:

A. The most hopeful cases, in number twenty-seven.

B. Less hopeful cases, in number twenty.

C. Cases probably hopeless from the first, in number twenty-three.

Symptoms of middle meningeal hæmorrhage.

Diagnosis from other conditions producing somewhat similar symptoms.

Treatment.

Prognosis.

Some points in the anatomy of the middle meningeal artery: those parts of the skull with which it is in contact, and the brain which lies subjacent to this region.—The largest of the branches of the internal maxillary, and by far the chief of the arteries which supply the dura mater, the middle meningeal, having entered the skull by the foramen spinosum, runs backwards a little way and then, ascending quickly, divides into two main trunks, an anterior and larger, which runs upwards and forwards to the anterior inferior angle of the parietal bone, in which it forms a deep groove, frequently a perfect canal, and a posterior, which runs backwards across the squamous part of the temporal. The anterior afterwards divides into branches, usually two, long and flexuous; the further distribution of which division varies much. Sometimes (fig. 1, Pl. IV) they subdivide but little, at other times (fig. 2, Pl. IV) the subdivision of the branches of the anterior part of the middle meningeal is far more complex and minute, and the parietal bone is covered with a close network of ramifying vessels. Another point of practical importance is that the posterior division of the middle meningeal artery nearly always runs across the squamous part of the temporal bone with a horizontal sweep, this bone being the very thinnest part of the vertex of the skull.

Further examination shows that the anterior inferior angle of the parietal bone which is grooved or tunneled by the anterior and chief division of the middle meningeal artery is another very thin spot in the side of the vault of the skull; this being accounted for by the fact that, owing to its prolongation downwards, it is the point of the bone farthest removed from the eminence or centre of ossification, and that it is entirely wanting in diploë.

This weakness is compensated for no doubt by the way in which this anterior inferior angle is overlapped by the great wing of the sphenoid, but it will be pointed out, pp. 151 and 152, that the way in which this same angle is wedged in may cause vibrations, and, in case of greater violence, fractures to choose this part of the skull as a path by which they may travel down into the base.

Attention has been drawn to the important thinness of the squamous part of the temporal and the anterior inferior angle of the parietal; if a skull which has been bisected antero-posteriorly be examined from within it will be found that though the bones are of quite average thickness elsewhere, there is often striking thinness and translucency along the track of the above-mentioned branches of the middle meningeal (fig. 3, Pl. IV). The importance of these weak spots is manifest, as they and the arterial branches which are in their close vicinity may be easily reached by "starring" lines which will find their way into them from a fracture which is actually at some distance off. The minuteness and extent of the fissure fractures which so frequently are found to have opened the middle meningeal are alluded to at p. 158. Furthermore this thinness of the side of the skull, which is always met with over the anterior inferior and indeed all the lower part of the parietal bone, and the squamous part of the temporal, and which is often present along the great branches of the artery, readily accounts for the very slight injury which occasionally serves to bring about rupture of the middle meningeal artery, *e. g.* in Cases 1, 2, 3, and 4.

The writer would venture to point out here that perhaps we do not pay sufficient attention to the varying thickness of skulls. He does not now refer to the varying thickness of the same skull at different points, but to the importance of remembering that while the average thickness may be, as given by Mr. Holden,[1] about one fifth of an inch we have occasionally to deal with skulls whose thickness is very different, and that quite apart from questions of age and of diploë. Thus in Case 30, p. 208, the skull was so extremely thin over the anterior inferior angle of the parietal bone that the crown of bone was cut through over almost the entire circle, with only six half

[1] 'Landmarks, Medical and Surgical,' p. 5.

turns of the trephine handle, the pin having been withdrawn after the fourth. On the other hand, as an instance of an exceedingly thick and dense skull, Mr. Hutchinson[1] relates a case in which after a fall in the street, hæmorrhage into the arachnoid cavity had led to fatal compression. His words are: "It seemed probable that in this case the great strength of the calvaria had permitted the reception of a very severe blow or fall without fracture; and that in consequence blood-vessels had been ruptured at various places, and the lateral sinus had given way."

Turning for a moment from the anatomy of the parts concerned in the extravasation to the violence which causes it, we shall see later on that this, as is so common in head injuries, is of two kinds. In one class of cases the injury is localized to the side of the head, perhaps to the parietal or squamous bone only, as in cases of some slight tap or blow, or, where the violence is greater and causes a fracture, perhaps compound, with depression, the bones now implicated being the parietal, the squamous, and the frontal slightly, and the mischief, though more extensive, being still over the middle meningeal area. It is in this class of meningeal extravasation that the surgeon will make use of the trephine and elevator with greatest hope, though in the latter cases, owing to the depression and greater violence, there will be grave risk of the presence of rupture of more than one branch of the middle meningeal, of laceration of the dura mater, and contusion of the brain being present at the time, and of the subsequent onset of ostitis and arachnitis. In the other class the injury which causes the extravasation is of a much more serious kind, inasmuch as it is only part of another fracture which, starting from some spot, usually in the vault, implicates as it runs downwards into the base of the skull the middle meningeal artery.

The shock of a blow which falls on the upper part of the parietal bone, not sufficiently violent to cause a fracture, will be weakened by the sutures between the parietal and its fellow, the occipital and frontal bones, and will be further dissipated by being carried down along the posterior and anterior angles of the parietal bones till it is finally dispersed and lost in the

[1] 'Lond. Hosp. Reports,' vol. iv, p. 24. The whole case is quoted at p. 291 of this paper.

masses of cancellous tissues which it meets with in the mastoid and frontal bones, from which, as from abutments, the parietal bone springs like an arch.

But a blow too violent to be weakened and dissipated by the above means, as from a fall from a height on to the head where the cranial bones are violently compressed between the ground and the weight of the trunk, is very likely to cause a fracture which, running down through the middle meningeal area, *i. e.* the parietal, squamous, and great wing of sphenoid, and rupturing an arterial branch, makes its way into the middle fossa and inflicts the further grave injury of fracture of the base of the skull. *Vice versâ* a fracture beginning in the base of the skull and involving the sphenoid bone may send a fissure upwards and outwards through the thin spot represented by the anterior inferior angle of the parietal bone and thus cause a rupture of the artery.

The importance of the above facts, the evident result which they have of interfering with, and adding difficulties to, the diagnosis, and of rendering grave the prognosis by the complicated injuries which they produce, need only be alluded to here.

Before considering what part of the brain is subjacent to the middle meningeal area, it will be well to recall the landmarks of the chief sutures which are met with between the bones in that region.

The point where the coronal suture, the anterior limit of the parietal bone, leaves the sagittal may be found by drawing a line from a point just in front of the external auditory meatus straight upwards on to the vertex; from this point, the bregma (Woodcut 1*), the coronal suture runs downwards and forwards roughly speaking to the middle of the zygomatic arch, or more exactly, to join the temporal part of the great wing of the sphenoid, which it meets an inch and a half above the zygoma and not quite an inch behind the external angular process of the frontal bone. Fig. 3, Pl. IV, shows what has been pointed out at p. 150, the thinness of the bone in the neighbourhood of the coronal suture, just behind which large branches of the middle meningeal artery are running.

The occipito-parietal or lambdoidal suture (Woodcut 1**), the posterior limit of the parietal bone, will be marked out by

a line which starts from a point two and three quarter inches above the external occipital protuberance, and runs forwards and downwards to its termination, which will be found on a level with the zygoma, an inch and a quarter behind the pinna.

Owing to the irregularity of its curve and serrations, the line of the squamoso-parietal suture (Woodcut 1***) is not quite so easy to mark. Its highest point is usually an inch and three quarters above the zygoma.

Woodcut 1.



* The bregma, or point where the coronal suture, the anterior limit of the parietal bone, leaves the sagittal suture.

** The occipito-parietal suture or posterior limit of the parietal bone.

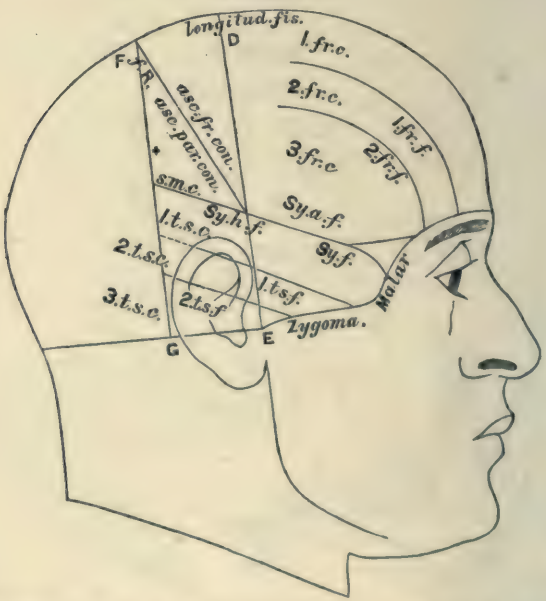
*** Squamoso-parietal suture or inferior limit of the parietal bone.

Lastly, before leaving the anatomy of the middle meningeal area, it will be well worth while to consider that part of the brain which lies subjacent. For, as is well known, this portion, including as it does the fissure of Rolando and its contiguous convolutions, contains the motor area, and it will be shown, later on, that one element of difficulty in the diagnosis and

treatment of ruptured middle meningeal artery is the injury which may be simultaneously inflicted on the brain.

The writer knows of no better way of remembering the chief convolutions and fissures which enter into the above area than that described by Dr. Reid in a paper in the 'Lancet'[1] from which Woodcut 2 is taken. With it may be compared Woodcut 1, taken from Dr. J. B. Roberts's paper[2] on 'The Operative Surgery of Human Brain,' as it shows the relation

WOODCUT 2.



+ Most prominent part of parietal eminence. *f. R.* Fissure of Rolando. *Sy. f.* Sylvian fissure. *Sy. h. f.* Horizontal limb of Sylvian fissure. The ascending limb would start two inches behind and a little above the external angular process, running straight up for an inch between the letters *a* and *f.* of *Sy. a. f.* 1 and 2 *fr. f.* First and second frontal fissures. 1, 2, 3 *fr. c.* First, second, and third frontal convolutions. 1 and 2 *t. s. f.* First and second temporo-sphenoidal fissures. 1, 2, 3 *t. s. c.* First, second and third temporo-sphenoidal convolutions.

of the chief centres met with in the middle meningeal area to the surface of the skull, and the sutures which have been described on pp. 152 and 153 as extending into that area.

The following are the chief directions given by Dr. Reid:

Fissure of Sylvius (Woodcut 2, *Sy. f, Sy. a. f, Sy. h. f*).—

[1] Sept. 27th, 1884, p. 539. [2] 'Annals of Surgery,' Sept., 1885, p. 118.

Draw a line from a point an inch and a quarter behind the external angular process of the frontal bone to a point three quarters of an inch below the most prominent part of the parietal eminence. Measuring from before backwards, the first three quarters of an inch of this line will represent the main fissure, and the rest of the line will give the horizontal limb. The ascending limb will start two inches behind and slightly above the external angular process, and run vertically upwards for about an inch.

Fissure of Rolando (Woodcut 2, *f. R*).—To find this and, at the same time, the ascending frontal and parietal convolutions first find the longitudinal fissure (Woodcut 2, *longit. fis.*) (a line running from the root of the nose to the external occipital protuberance), and the horizontal limb of the fissure of Sylvius, next from a base line running through the lowest part of the infra-orbital margin and the centre of the external auditory meatus draw two perpendicular lines to the top of the cranium, one (D E) from the depression in front of the external auditory meatus, and another (F G) from the posterior border of the mastoid process. We shall then have described on the surface of the head a four-sided figure bounded above and below by the lines for the longitudinal fissure and horizontal limb of the fissure of Sylvius respectively, and in front and behind by the two perpendicular lines. If we now draw a diagonal line (*f. R.*) from the posterior superior to the anterior inferior angle of this space, the line will lie over the fissure of Rolando.

In the majority of cases the fissure of Rolando does not actually run into the fissure of Sylvius, a convolution bulging across at that point, hence the lowest half inch or so of the line would cross the convolution.[1]

The *frontal lobe* (the posterior part of which enters into the middle meningeal area) will be bounded above by the longi-

[1] Prof. Thane ('Erichsen's Surgery,' i, p. 731) gives the following directions for finding the fissure of Rolando: "The upper end of the sulcus of Rolando is found about half an inch behind a point midway between the root of the nose and the external occipital protuberance, its lower end is close to the posterior limb and about an inch behind the bifurcation of the fissure of Sylvius. The bifurcation of the fissure of Sylvius corresponds to a point one and a quarter inches behind and one quarter of an inch above the level of the external angular process of the frontal bone."

tudinal fissure, below by the line for the trunk and horizontal limb of the Sylvian fissure, behind by the fissure of Rolando, and in front by a line just above and parallel with the supra-orbital margin. A line drawn from the supra-orbital notch backwards to within three quarters of an inch of the fissure of Rolando and parallel with the line for the longitudinal fissure will indicate the first frontal fissure. The frontal part of the temporal ridge will indicate the second frontal fissure. The first, second, and third frontal convolutions will thus be mapped out. The ascending frontal convolution (*asc. fr. conv.*, Woodcut 2) will occupy a space about three quarters of an inch broad, parallel with and in front of the line for the fissure of Rolando.

The parietal lobe.—The ascending parietal convolution (*as. par. conv.*, Woodcut 2) is the only one which enters importantly into the middle meningeal area; it lies parallel with and behind the fissure of Rolando, between it and the parietal eminence.

As the arrangement of the other convolutions which form the parietal lobe is somewhat variable, and as the branches of the middle meningeal artery have ceased to be of any size by the time they reach the parietal eminence behind which most of the parietal lobe lies, it has not seemed worth while to give the careful directions of Dr. Reid for mapping out the rest of this lobe and its convolutions.

Temporo-sphenoidal lobe (Woodcut 2).—A line running about an inch below and parallel with the main trunk and horizontal limb of the fissure of Sylvius will indicate the first temporo-sphenoidal fissure, and another about three quarters of an inch below and parallel with the last will indicate the second. Thus, the first, second, and third temporo-sphenoidal convolutions will be mapped out.

The conditions which are liable to be met with in the parts concerned in middle meningeal hæmorrhage:

1. *The condition of the skull.*—While in the great majority of cases the skull is fractured, and the middle meningeal or one of its chief branches laid open where the fracture crosses the vessel, the existence of a fracture is not necessary for the production of middle meningeal hæmorrhage. Thus, in the two cases of Mr. Erichsen (2 and 3, pp. 165 and 166), in

which fatal laceration of the artery took place from very slight injury, no fracture existed. In Mr. Cock's most interesting and successful case, already published in these 'Reports,'[1] it is stated that "not the slightest evidence of any fracture could be detected" after reflecting the soft parts previous to trephining. Again, in the case of G. M—, recorded p. 242, while all three fossæ of the skull were fractured on the *left* side no meningeal extravasation occurred on this side of the skull, though it was so severely damaged. The post-mortem record goes on to state: The left temporo-sphenoidal lobe was much bruised, "but not nearly so much as on the *right* side and corresponding spot. Here the convolutions were extensively pulped and the middle fossa lined by a considerable thickness of clot. On scraping this away carefully a branch of the middle meningeal artery was found to be torn. How this occurred it is difficult to say,[2] as there was no fracture whatever on this side."

As bearing upon this subject of middle meningeal hæmorrhage *without* fracture, it may be mentioned here that Sir C. Bell long ago[3] pointed out that this form of extravasation may take place without any fracture being present. The following are his words:—"It is extraordinary that anyone who has ever raised the skull-cap in dissection, and felt the strength of the universal adhesions of the dura mater to the lower surface of the bone, could for an instant believe that the arteria meningea media has power of throwing out its blood to the effect of tearing up these adhesions from the entire half of the cranium! Strike the skull of the subject with a heavy mallet; on dissecting you find the dura mater to be shaken from the skull at the point struck. Repeat the experiment on another subject, and inject the head minutely with size injection, and you will find a clot of the injection lying betwixt the skull and dura mater at the part struck, and having an exact resemblance to the coagulum found after violent blows on the head. I imagine this is conclusive."

[1] Vol. vii, 1842, p. 157, and sequel, 1857, p. 364. See also p. 174 of this paper.

[2] The dura mater was probably here detached by contrecoup, sufficiently to injure the artery and produce extravasation, as is explained by Sir C. Bell's experiments.

[3] 'Surg. Observ.,' 1816, pp. 466-7.

On the other hand, one of the most recent writers on head injuries, Dr. Nancrede, 'International Encyclopædia of Surgery,' vol. v, p. 45, writes as follows: "From whatever source proceeding the hæmorrhage is large in amount from the extensive coexistent separation of the dura mater." And in footnote 2, same page, "Although the primary separation effected by the blood is the chief factor in this condition, yet a collection of fluid blood, once formed between the dura mater and the bone and communicating with an open artery, must, upon well-known hydrostatic principles, tend to extend and to dissect off the membrane still further until clotting occurs."

This primary detachment of the dura mater to which the meningeal extravasation is secondary will account for those cases, *e.g.* those quoted by Mr. Erichsen, in which no fracture was present. In that of the child, Case 2, p. 165, such primary detachment of the dura mater is at first surprising, as the adhesions between the membrane and the skull are known to be greater in early life than in adults. But, as bearing on this point, the bone at this time of life would be more yielding, and thus would escape the chief stress of the injury.[1]

Where a fracture does exist it may be incomplete, *i.e.* through only one table. Thus in Case 1, p. 164, "no fracture of the external table existed, but a slight crack extended across the internal plate." In Mr. Plimmer's case, p. 166, "there was a fracture, incomplete, of the right parietal bone."

In cases, again, where a fracture exists and implicates both tables of the skull, it may be most minute, quite impossible to feel through even a thin scalp, and not readily recognisable, even when the periosteum is reflected. Thus in a case recorded by Mr. Cock, p. 180, "there was a minute fracture of the parietal bone;" the same condition of things, a mere

[1] Mr. Davies-Colley has kindly drawn my attention to an explanation of the above facility with which the dura mater may be separated, whether by a blow or by an extravasation consequent on the blow from the cranial bones. It is the explanation of M. Tillaux that the adhesions between the dura mater and the bone are particularly weak in the temporal fossa. The following are his words: ('Anatomie Topographique,' p. 43), "Et remarquons que la point du crâne où cette adhérence est le plus faible, où elle est presque nulle, c'est précisement la fosse temporale, c'ést-à-dire l'endroit où le trouvent les branches principales de l'artère méningée moyenne."

thread-like fissure, was met with in the parietal and temporal bones of the case recorded by the writer, p. 208.[1]

The above facts as to the possibility of a fracture being absent, or, if present, incomplete or minute, show how imperative it is to persist in trephining where the history and symptoms point to middle meningeal extravasation, though locally there may be no external manifestations of it.

In the great majority of cases not only is a fracture present, but it is of grave extent (Woodcut 4). Thus out of seventy cases of middle meningeal hæmorrhage a fracture was present in sixty-two. Of these sixty-two the fracture implicated base as well as vault in no fewer than thirty-eight. In four cases it is stated that there was no fracture; in three (which recovered) no fracture could be detected, and in one only is there no evidence as to whether a fracture existed or not.

2. *Condition of the brain.*—It has just been shown how frequently, in thirty-eight out of sixty-two cases, the base of the skull is involved in the fracture which causes the extravasation. It is a point of some practical importance that these fractures of base do not necessarily mean any such lesion as ecchymosis or contusion of the brain. Concussion and compression had of course been inflicted in all, but in nineteen out of the thirty-eight cases in which the fracture implicated the base, bruising and laceration of the brain were either absent altogether, or were slight or trivial.

Looking at the condition of the brain from another point of view, not now in its relation to the fracture, out of seventy cases of middle meningeal hæmorrhage the condition of the brain is not mentioned

In 25, in ten of which recovery took place.
In 12 it is stated that there was no bruising of brain, *i.e.* no injury to it beyond compression.
In 15 the bruising is "slight," "trifling," or "trivial."
In 8 there is simply mention of "bruising," or "ecchymosis."
In 10 the ecchymosis or contusion are described as "great," "extensive," "severe," &c.

70

[1] Other similar cases will be found recorded at pp. 191, 194.

In this third group of cases where the brain is much injured, the contusion and laceration will be found not, as a rule, where the brain is depressed and flattened at the site of fracture and extravasation, but on the under surface of the temporo-sphenoidal lobes, especially that opposite to the fracture, and the frontal lobes; the brain tissue in these parts, which bear the chief stress of the injury, being not unfrequently pulped, even to the depth of an inch. In two of the ten cases of severe injury to the brain the ventricular fluid was bloody, and in one of these the septum lucidum was torn.

In one case of Mr. Hutchinson's, quoted at p. 215, he pointed out the exceeding paleness of the brain-substance, and remarked that in all probability the manner in which concussion proves fatal is by squeezing the blood out of the brain-substance.

3. *Condition of middle meningeal artery. Site of lesion in it. Amount and condition of clot, &c.*—While in the great majority of cases it is possible, by the aid of a bristle or fine wire, or by injecting water along the common carotid, to prove the existence of a laceration in the middle meningeal artery or one of its branches, and to detect its exact site; in one or two out of the number of fatal cases, viz. sixty, on which this paper is based, it is stated that no laceration of the artery could be detected, though large extravasations were present. In such cases it must be small branches or terminal ones which are injured either by the line of fracture crossing them, or by the concussing violence of the fracture which causes detachment of the dura mater which supports them.

It will not be surprising if an examination, as opportunity offers, of a larger number of cases shows that lesion of the trunk or a large branch of the middle meningeal artery causes considerable hæmorrhage and coma not long delayed, and on the other hand a rupture of one or more small branches will be followed by a smaller hæmorrhage, perhaps arrested and then repeated, and that consequently the coma of these cases will be delayed and less marked, p. 260.

An examination of the cases in which a laceration of the artery or its branches was found, shows, the writer thinks, that in cases of this hæmorrhage the trunk of the artery has had somewhat of an undue prominence given to it, thus:

In three cases the anterior division was injured.

In seven cases the posterior division was injured.

In fourteen cases it was "a branch" or "branches."

In only two is it the trunk which is specified as injured, but in four others this was probably the case. In nineteen it is only "the middle meningeal" which is mentioned. In the remaining cases there is no evidence to show what part of the vessel was opened.

The writer draws attention to the above facts as he considers that as the trunk of the artery is comparatively seldom injured the directions usually given for trephining over the trunk are somewhat misleading, and that the site usually given for trephining, viz. half an inch above the level of the external angular process, and an inch and a half behind this process[1] should be reserved for cases where the pupil on the side of the head injured is widely dilated, thus indicating that the coagulum is extending low down, and causing pressure upon the third nerve, p. 272.

4. *Mode of extravasation.*—The following cases will show that this may take place in at least three ways, viz.

(α) Cases in which the extravasation is rapid, and quickly fatal.

(β) Cases in which the extravasation is delayed for some time.

(γ) Cases in which the extravasation takes place in two stages, the first slight and producing no coma.

Amount and condition of coagulum.—Two to three ounces is a common quantity to find mentioned in the accounts of the post-mortem examinations of these cases. In one the quantity is four ounces and in the writer's second case, p. 209, quite four ounces were removed at the time of the trephining, but fully another ounce appeared to be left behind. In one case the quantity mentioned is six ounces, and here death took place an hour and a half after the admission of the patient.[2] In one extraordinary case, No. 19, p. 187, the quantity is stated to have been eight or nine ounces on either side of the head.

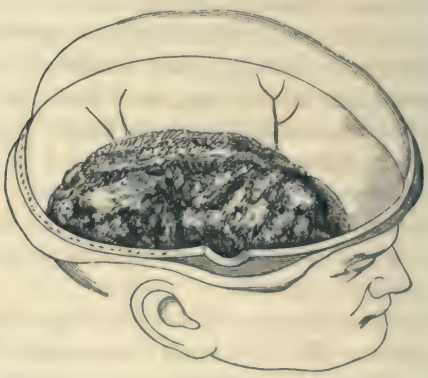
The colour of the clot is nearly always dark, usually black,

[1] Holden, 'Landmarks, Medical and Surgical,' 3rd edit., p. 5.

[2] Case 44, p. 227.

this being, perhaps, due to the facts that the accompanying veins are opened as well as the artery, that as soon as compression takes place both the arterial and venous currents are interfered with but with different results, the former being gradually diminished until the clot is removed, when it may break out again, but the venous blood continuing to escape as the dura

Woodcut 3.



Middle meningeal hæmorrhage in a patient of Mr. Hilton's. Drawing 80[30] Guy's Hospital Museum. The ruptured meningeal artery was situated just in front of the trephine opening. The bone was trephined with relief; afterwards blood passed from the corpus striatum into the lateral and so to the fourth ventricle. The symptoms preceding death were difficulty of deglutition and respiration.

mater becomes loaded with blood owing to the local pressure on the middle meningeal vein below, and also from the interference with the venous circulation generally which is caused by the embarrassed respiration.

Whatever the clots may be likened to in shape, viz. to a cake or disc, they are always thick in the centre, often an inch thick, thinning away towards their defined margins.

They are frequently as large as an adult palm, and extend as far as the finger can reach, even after the trephine opening has been freely enlarged.[1]

Their consistence, when poured out slowly, is firm, dry lacking in serum, granular, and not easily broken down

[1] See the account in Cases 19 and 28, pp. 189, 201.

When the extravasation takes place rapidly as from the trunk, or one of the chief divisions, the clot is soft like black-currant jelly, and adheres much less firmly to the bone and dura mater than in the former case.

WOODCUT 4.[1]



Middle meningeal hæmorrhage with extensive fracture of the skull. Prep. 1593[61] Guy's Hospital Museum.

Occasionally the consistence is twofold; in part firm and tough, in part soft, jelly-like, and recent.

It will be shown, later on, how the consistence of the clots may be affected by the history of the case.

Cases of middle meningeal hæmorrhage.—These fall into the three following groups:

A. *The most hopeful cases for trephining.*—Violence comparatively slight. Laceration of middle meningeal artery, or its branches. Fracture of skull, if present, slight and localized to side of skull, *i.e.* not implicating base. Compression, but

[1] For this woodcut I am indebted to Mr. Hogarth, an accomplished draughtsman as well as a most competent dresser.

little or no contusion or laceration of brain. Twenty-seven cases.

B. *Less hopeful cases.*—Violence greater. Laceration of middle meningeal or its branches. Fracture implicating base, *i.e.* middle fossa. Some injury to brain, but this only trivial. Twenty cases.

C. *Cases probably hopeless from the first.*—Violence very great. Laceration of middle meningeal artery or its branches. Fracture of skull very extensive, perhaps implicating several bones and sutures, both in vault and base. Injury to brain very severe. Twenty-three cases.

A. The most hopeful cases for trephining; violence comparatively slight. Laceration of middle meningeal artery, probably in its branches, not the trunk. Fracture of skull, if present, slight and localized to side of skull, *i.e.* not implicating base. Compression present, but little or no contusion or laceration of brain.

In this group of cases these is extravasation of blood and compression of the brain, but very little more. There may be detachment of the dura mater without any fracture, or a fracture may be present. But, if so, whether simple or compound, it is localized to the neighbourhood of the injury of the artery, there is no extension-fracture into the base; no laceration of the meninges and little or no injury to the brain, either of that immediately subjacent, or of that in other parts, by contrecoup. It is obvious that in these uncomplicated cases trephining is not only imperatively demanded, but that it may be resorted to with great hopes of success. Unfortunately such cases are not common: of the seventy cases on which this paper is based, twenty-seven belong to this first group.

Case 1. *Slight violence; fracture of skull, internal table only; no extension into base; extravasation from middle meningeal artery; some bruising of brain localized to site of extravasation; death three and a half hours after the injury.*[1]—A cricket ball was one evening thrown up and struck deceased, a muscular lad, on the right temple. He staggered, but did not lose consciousness, and complained little of pain. He

[1] Reported by Mr. Edwards, 'Ed. Med. Journ.,' 1862, ii, p. 191.

came home about eight, and soon afterwards vomited. Mr. Edwards saw him at nine and ordered cold. He soon became delirious and tossed about; slept occasionally, and in the intervals expressed great anxiety that the boy who threw the ball should not be blamed. He became gradually comatose and died three and a half hours after the blow. Below the scalp there was a very scanty extravasation under the temporal aponeurosis on the right side; no fracture of the external table existed, but a slight crack extended across the internal plate. The middle meningeal artery was completely torn through here; a clot half the size of a fist lay between the bone and the dura mater, the corresponding part of the brain being distinctly bruised.

Remarks.—This case, together with the three that follow immediately, show how slight and apparently trivial and unimportant the injury which suffices to cause fatal middle meningeal extravasation may be. It also brings out the following points: the great rapidity with which death sometimes occurs in these cases, viz. three and a half hours only after a slight injury; moreover it shows how far from typical the symptoms may be. Thus there is scarcely any concussion, "the boy staggered but did not lose consciousness . . . he came home, and shortly after vomited." Later on there is delirium and restlessness, followed by intervals of sleep and consciousness, coma setting in late, and followed quickly by death. The absence of any fracture of the external table is also very noteworthy from a practical point of view with reference to the question of trephining.

The two following cases are related by Mr. Erichsen:[1]

Case 2.—Some years ago a little girl was going downstairs with her mother to dinner. She said, "I will go first, Mamma," and started to run downstairs, but she missed her footing and fell forwards, striking her head slightly against the wall. She felt a little dazed at the time, but went to her dinner, ate, and afterwards felt slightly sick. She was sent to bed, slept soundly, and was dead next morning. There was a clot found between the dura mater and the skull on the side of the head that had been struck, but without any fracture.

[1] "Clinical Lect. on Injuries of the Head," 'Lancet,' 1878, vol. i, p. 2.

Case 3.—"Many years ago I was called to see a lady who had come up to town for a few days to amuse herself. She went to the Opera, and in going downstairs caught her foot in the train of a lady's dress. She fell forwards and struck her head against the opposite wall. She felt a little giddy and said that she would return home. She went to bed, fell asleep, and about 10 a.m., when the maid came to call her, she found her so fast asleep that she did not like to disturb her; but about 12 o'clock the friends got alarmed and sent for a neighbouring medical man, and he came for me. I found her comatose, suffering from compression of the brain, and went home to get my trephines, but when I came back she was dead. A post-mortem examination was made, and we found a clot of blood, the size of a small saucer, on the side that was struck, between the skull and the dura mater, over the course of the middle meningeal artery, but without any fracture of the skull."

Remarks.—The absence of any fracture in some of these cases of middle meningeal extravasation has been referred to above, together with Sir C. Bell's experiments and explanation of the fact, p. 157. The influence of the meal in the case of the little girl, and the restlessness in the boy whose case is reported by Mr. Edwards in exciting the hæmorrhage fatal in either case, may be here alluded to. Another case in which the extravasation appeared to follow quickly on taking food will be found at p. 214.

Case 4.—*Incomplete fracture of right parietal bone; middle meningeal hæmorrhage; no laceration or ecchymosis of brain; death within twelve and a half hours after the injury.*—F. H. B—, æt. 3¼, always an unhealthy child, strumous, long-suckled, fell October 27th, 1883, at 2 p.m., out of a swing about two foot six inches on to his head. Nothing serious was thought of it, nor any medical man sent for. At 8 p.m. he "had a fit," and as the child was in the habit of having fits, and as no history of injury was given, and as no bruising was detected, bromide of potassium was ordered. Unconsciousness set in with stertorous breathing, and the child died at 2.30 a.m. the next day.

Post-mortem examination.—Fracture incomplete of right

parietal bone. No external bruising, but some discoloration beneath pericranium, a large clot from the middle meningeal artery over the right side of the brain. Cranial bones thin and expanded. Ventricles large, with a quantity of fluid in them.

The above case, for which the writer is indebted to his friend, Mr. H. G. Plimmer, of Norwood, shows, together with the two of Mr. Erichsen's given above, and Mr. Bryant's at p. 191, that these cases of middle meningeal hæmorrhage are not confined to hospital practice, and also that, from insufficient or misleading information, a correct diagnosis may be a matter of great difficulty.

Case 5.[1] *Depressed fracture of skull from blow with a spade; middle meningeal hæmorrhage; elevation of bone; recovery.*—"In the year 1839 a man was struck with a spade just over the anterior inferior angle of the right parietal bone, and when he came to St. George's Hospital, a few minutes afterwards, a compound fracture with depression of a small piece of the skull was detected, but there were no cerebral symptoms whatsoever. Shortly afterwards, however, the patient became heavy and stupid; and coma was gradually supervening when Mr. Keate arrived, and at once proceeded to remove the depressed bone, whereupon a jet of blood spirted out from a large branch of the middle meningeal artery, all symptoms of compression were immediately relieved, and the patient recovered."

Contrasting strongly with the one just mentioned, both in the severity of the injury and the time which had been allowed to elapse before the patient was brought to the hospital, is the following case, also successful, and recorded by Mr. Erichsen:[2]

Case 6. *Fall from a carriage-box; starred fracture of side of skull; middle meningeal hæmorrhage; three days' coma; trephining; recovery.*—A coachman was thrown off his box, and slowly became comatose. Three days after the accident

[1] Sir P. Hewett, 'System of Surgery,' edited by Mr. Holmes and Mr. Hulke vol. i, p. 576.

[2] 'Lancet,' loc. supr. cit.

he was brought to University College Hospital, perfectly comatose, with some paralysis of the side opposite to the fracture. On cutting down a starred fracture was found in the right temporal region. Trephining was performed and a large clot was found under the bone. Some blood welled out rather freely, evidently from the middle meningeal artery. The patient made a good recovery and "was able to go about his ordinary avocation as if nothing had occurred."

Mr. Erichsen goes on to say, "During his convalescence he presented one of those peculiar physiological phenomena I mentioned in a former lecture. He commenced to swear 'like a trooper.' Some four or five years after this, one day, as I was going home, a cabman came up, touched his hat to me, and said, 'Do you recollect me, Sir?' I said, 'No.' He said, 'I am Jim; I daresay you recollect me, Sir, because I used to swear so horribly.' I found that he was quite well and able to go about his ordinary avocation as if nothing had occurred, although he had a deep depression at the seat of the trephine opening."

Case 7.[1] *Fracture of skull in temporal region; middle meningeal extravasation; interval of consciousness short but well-marked; trephining; complete recovery.*—A young man was knocked down while fighting and was stunned; he speedily recovered his senses, and was brought to the London Hospital complaining of pain in his head. As he walked along the ward he began to stagger, and with difficulty reached his bed; his breathing became stertorous, and he was evidently hemiplegic. A swelling was found in the temporal region of one side, and on dividing the skin a fracture was detected. The trephine was instantly applied, and a large coagulum was found on the surface of the dura mater. He recovered completely.

Case 8.[2] *Middle meningeal extravasation caused by a fall in an epileptic fit, the extravasation taking place on the side opposite to that injured by the fall; trephining three days after the*

[1] Related by Mr. Adams, in his article on "Injuries of the Head," 'Cooper's Surg. Dict.,' vol. i, p. 916.

[2] By Dr. H. Watson, late Surgeon to H.M. Steam-Transport "Golden Fleece," 'Lancet,' 1856, ii, p. 249.

injury; complete recovery.—J. H—, æt. 27, a spare, delicate-looking man, the Boots in the "Golden Fleece," was seized on the 18th of April, at the commencement of a voyage to the Crimea, with a fit of epilepsy, for which I was called to see him. I found him lying on the deck with all the usual symptoms of that affection. In a few minutes he recovered his consciousness and was able to answer my questions, and walked to his berth apparently well. On my seeing him half an hour afterwards, to my surprise I found him drowsy, stupid, and nearly insensible; in an hour's time he became completely so. His pulse became full, slow, and labouring; the pupils fixed and dilated; the skin hot, and the motions passed involuntarily. I ordered his head to be shaved, and carefully examined it to see if there was any external fracture. None, however, was perceptible, a slight bruise only being visible on the right side. I therefore ordered a large blister to be placed on his scalp, fifteen grains of calomel to be given through the medium of butter, and a strong turpentine enema to be injected. In the evening the right side of his body was completely paralysed, and there was no improvement whatever.

For three days this state of things continued, the same treatment being resorted to. I was now convinced that unless something further was quickly done he would sink, and that, from the symptoms of the case, it was compression from extravasation. Bearing in mind Mr. Hilton's opinions on these cases, on the 22nd I trephined over the site of the middle meningeal artery on the left side. On removing the bone, to my great pleasure I found a large clot of blood between the bone and dura mater. This I removed, and in two hours afterwards the man had recovered his consciousness, and could speak distinctly and rationally; the paralysis also entirely disappeared. He went on well for the next four days, and on our arrival at Malta I sent him to the hospital there, as it would be some time before he was able to attend to his duties. At the expiration of a month the wound had nearly healed, and he had nothing whatever to complain of. I therefore ordered him on board to resume his duties. In a couple of weeks the wound had entirely healed, and he went on performing his duties till our arrival in England in July, when he was discharged perfectly well.

Remarks.—The above case must always rank as one of the most satisfactory and creditable cases of middle meningeal hæmorrhage, especially when the difficulties of performing such an operation as trephining on board ship are borne in mind. The following points in the case are also worthy of note. The rupture of the middle meningeal artery without any fracture of the skull from a fall in an epileptic seizure; the fact that the extravasation took place on the side opposite to that struck by the patient in his fall (cf. Case 50, p. 233); the long interval, over three days, between the date of the extravasation and the time of the trephining, in which respect this case resembles closely that of Mr. Erichsen's, Case 6, p. 167.

Case 9. *Rupture of middle meningeal artery and extravasation occurring probably without any fracture of skull; trephining; recovery with subsequent contraction of the limbs opposite to the side of extravasation.*—H. H—, æt. 10, a Fin, was admitted under Mr. Howse's care on the night of July 26th, 1884. He had been playing, about 6 p.m., on board a ship in the Canada Dock, when he fell about six feet into the forehold, striking the left side of his head and the left shoulder. When picked up he was quite conscious, but vomited for about an hour. This passed off, and he remained quite conscious till 10 p.m., when he asked for a drink of water, and then went into the state in which he was when admitted, about 12.30 midnight. His condition then is thus reported:—He lies on his back in a state of coma, pupils unequal, the left more dilated than the right. The right pupil contracts sluggishly to light, the left not at all. Limbs all rigid; legs straight; right arm and leg convulsed. Convulsive movements of arm more marked than those of leg; right hand clenched; on the left side the forearm is flexed and the wrist and hand doubled in; slight swelling of all the left side of head and a graze behind left outer canthus. Respiration of a moaning character at times, at others stertorous. Pulse irregular, 78.

At 2 p.m. the next day Mr. Howse trephined the patient. The left side of the head being shaved the scalp was found to be much swollen and a little blackened. A crucial incision, of which each portion was 4 cm. long, was made about two inches above the ear. No fracture or depression to be made out on

reflecting the soft parts. Trephine used, and no fracture found on inner surface of bone removed, but a black mass of blood-clot welled up at once, with considerable bleeding, which did not yield to sponge pressure. It was then decided to suture the edges of the wound and apply digital pressure to the common carotid for three hours, and then, if needful, to tie the carotid; operation antiseptic throughout. Ice bag with freezing mixture (three parts of salt and two of ice) applied over the usual dressings.

At 5 p.m. the wound was redressed, a little blood-clot was found over the wound, but no more bleeding took place. Fresh dressings and icebag, &c., applied.

6.30 p.m.—Patient allowed a few teaspoonfuls of milk; grinds his teeth, and moves occasionally. Resp. quiet, 22. At times throws his right arm about, and also moves his right leg.

During the night the patient was continually trying to get in and out of bed.

July 28th.—This morning he is conscious, and answers questions in Finnish; takes his milk well; temp. 98·9°; pulse 120; pulled his dressings off in the night.

July 29th.—Had a better night, but is very restless this morning; iced mixture still applied; temp. 99°; it is noticed to-day that there is some left facial paralysis.

July 30th.—Again very restless in the night; a little ptosis of left upper eyelid; left pupil still a little dilated; dressings sweet, wound in good apposition; no recurrence of hæmorrhage.

From July 30th to August 20th.—The wound healed steadily, the patient being entirely free from any head symptoms save some dilatation of left pupil.

August 24th.—Patient walks about the ward dragging both legs, especially the right; drops the right shoulder a little; reflexes normal; left facial paralysis still marked.

September 3rd to 11th.—Patient still drags right leg; foot on this side assuming position of talipes equino-varus; right side seems colder than left.

October 8th.—The following position has now become constant: right leg much drawn up, and foot greatly inverted. Right forearm flexed and pronated to utmost extent, the thumb being turned in under the other fingers. Sole of right

foot turned up and in, all the toes, especially the big one, being curled so that the nails are not visible; right side of mouth more distinctly drawn up than left, when patient smiles. It is almost impossible to count the pulse on the right side as the tendons are continually twitching.

October 25th.—Gets about the ward in a crab-like fashion, pushing right foot in front of him; cannot put sole of this foot flat on the ground; hand and fingers as before.

November 17th.—Transferred to Philip Ward under Dr. Moxon.

March 5th.—Discharged; walked out with a crutch under left arm, extending right leg with a rotatory movement before putting it to the ground. Right forearm still flexed on chest as before, pronated and with fingers doubled under hand.

Remarks.—It is of course uncertain whether this most interesting case should have come here in Group A of simple uncomplicated cases of middle meningeal extravasation. The following were the chief causes for placing it here: the absence of any fracture at the site of trephining, the absence of any evidence of fractured base beyond the left facial paralysis, *i. e.* no bleeding or discharge from the ear, and the concussion symptoms being but little marked, the patient being conscious when picked up, but vomiting at intervals for an hour after, this being probably due to the evening meal having been taken just before the accident. Lastly, the rapid recovery of consciousness and power over the paralysed limbs after the trephining are quite against there having been laceration or contusion of the brain.

The delayed onset of the compression symptoms and the way in which these set in are noteworthy. Thus the lad continued conscious for about four hours after the injury, when some water was given him and the symptoms of compression followed immediately. It appears not improbable that laceration of the artery had taken place at the time of the fall, but that while the circulation remained depressed owing to the shock of the injury and the vomiting but little extravasation occurred, but as soon as a "drink of water" was given—it being very likely that the boy, very thirsty after the repeated vomiting, was allowed to drink freely—the circulation became more active and symptoms of extravasation at once appeared.

If this surmise be correct, with this case may be compared one of Mr. Hutchinson's, p. 214. Here the patient, also a boy, had been conscious up to 8 p.m. on the evening of the day after the accident; at this time the nurse gave him some bread and milk and he took it well. At 8.30 the house surgeon found him insensible and apparently dying, death taking place within a few minutes.

Most interesting questions arise as to the cause of the subsequent contraction of the limbs on the right side, and whether this could have been obviated by a more complete removal of the bone and, thus, of the clot at the time of trephining.

It is probable that the persistent hemiplegia and contraction of limbs on the right side are due to thickening and contraction of the dura mater and arachnoid, and thus to compression and wasting of the subjacent motor area. A somewhat similar condition, in a much earlier stage, is seen in those cases where, after an injury to the head, or, much more rarely, as in a case of Dr. Moxon's, of fatal erysipelas, a unilateral arachnitis is followed by partial hemiplegia on the opposite side.

While it is to be feared that this condition of contraction will become permanent, the twitching of the flexor tendons of the right forearm was probably due to irritation of the brain surface from contraction of the clot and thickened meninges, and this twitching will probably be only temporary, ceasing when the source of irritation ceases also.

How far, if at all, the contraction of the limbs on the right side which subsequently set in, marring the result of a case otherwise completely successful, might have been prevented by more complete removal of the clot at the time of the trephining is a very interesting and important, but withal a very doubtful matter.

My colleague, Mr. Howse, tells me that he disapproves of free removal of bone in such cases unless depressed, splintered, &c., on account of the risk which he considers is run of the scalp becoming later on (no longer supported by the skull at this spot) adherent to the dura mater, and thus by cicatricial contraction causing dangerous and even fatal brain-pressure. His attention was first drawn to this fact by a case of Mr. Cooper Forster's in which, after removal of bone from the vertex, this matting of dura mater and scalp took place slowly

after recovery and gradually proved fatal. The writer has been unable to find the record of this case, but Mr. Cooper Forster in conversation remembered the circumstances quite well, and added that it was a case of syphilitic necrosis and the removal of bone very free.

With reference to the above most important matter it seems on the one hand strange, if Mr. Howse's view be correct, why, like brain-pressure symptoms do not occur more frequently in those cases in which, in hospital practice especially, bone is freely removed from the skull for compound fracture, syphilitic necrosis,[1] &c.

On the other hand, however this may be, Mr. Howse's plan to rest content with the relief given by a very moderate removal of bone is abundantly borne out by such cases as 6, 7, 8, and 10, in which a completely successful result followed on simple trephining and removal of as much clot as was possible through the small opening thus given. This question is further discussed at p. 303.

Case 10.[2] *Middle meningeal hæmorrhage after severe fall upon head; no fracture of skull (?); long period of consciousness (? nine hours) after injury; trephining; successful result; death fifteen years after from brain-softening and hæmorrhage, espe-*

[1] The writer sees, from time to time, the three following cases: 1. A lad who, in 1878, came under his care, in the absence of Mr. Howse, with an extensive comminuted depressed fracture of skull, and "smash" of left arm, having been knocked down and run over on the South-Eastern Railway. While the arm was amputated by Mr. G. A. Wright, now of Manchester, numerous depressed fragments of bone, being quite loose, were removed from the frontal and parietal regions. 2. A somewhat similar case of a lad who, in 1881, was admitted under him, in the absence of Mr. Davies-Colley, for compound depressed fracture of parietal and frontal bones after a fall from the tail of a van, a paraffin-cask also falling on him. 3. A woman, of middle age, who, in 1884, after a previous trephining for syphilitic ostitis, had the entire left parietal bone removed for necrosis. All these patients have large slightly-pulsating gaps in their skulls covered over by scalp and dura mater only, and for which they wear felt or gutta-percha shields. While the third case is not of much value owing to its comparative recency, it may be here stated that all the patients follow active lives, and none show signs of brain-pressure. Similar and better instances must be familiar to every hospital surgeon.

[2] 'Guy's Hosp. Rep.,' 1842, vol. vii, p. 157. The sequel of the case is given in the same 'Reports,' 1857, vol. iii, 3rd series, p. 364.

cially in the parts originally injured.[1]—J. P—, æt. 46, was admitted into Cornelius Ward under Mr. Cock, at 7 p.m., September 2nd, 1841. While at work in an upper warehouse he had stepped backwards through an open door, and pitched upon his head from a height of about seventeen feet. He was stunned by the fall, but was recovering at the time of his arrival at the hospital, whither he was immediately carried. He had already lost much blood, for a severe scalp wound extended from the forehead along the vertex of the skull to within a little of the left of the occipital tuberosity, a flap being detached so as to expose about the upper third of the parietal bone. No fracture could be detected, and there was no bleeding from the ears. He was collapsed, but easily roused, had not vomited, and his pupils were obedient to light. He sat up to have his head shaved. About an hour after he was found to be bleeding profusely, and in a state approaching to syncope.

The bleeding came from innumerable small vessels along both edges of the wound, and was arrested by ligatures and pressure. The patient was perfectly sensible, though faint, and replied to questions put to him. There was no symptom whatever of any cerebral lesion. At midnight he had partially recovered from his collapse; his breathing was natural, his pupils somewhat contracted.

At 4 a.m. he got out of bed and passed his motions. When the nurse spoke to him he answered incoherently, as if asleep.

At 8 a.m. the dresser found his respirations to be laboured, stertorous, and interrupted, with entire loss of consciousness, his pupils contracted and insensible. These symptoms increased, and when Mr. Cock saw him at noon the case appeared almost hopeless. The breathing was then in the highest degree stertorous, rapid, and laborious. Pulse quick, weak, but rather sharp. Pupils somewhat contracted and insensible; no difference in the two eyes; the conjunctiva ecchymosed on each side. On pinching the left arm and leg they were freely and readily retracted, but not the slightest movement could be excited in either extremity of the right side. There appeared to be some paralysis of the muscles

[1] Anyone reading this report will be struck by its carefulness. It was taken by one of the dressers of that day, the late Mr. Poland.

on the right side of the face. Mr. Cock cut down upon the anterior inferior angle of the parietal bone, exposing the cranium freely. Not the slightest indication of any fracture could be detected, and a portion of the bone above and behind the anterior inferior angle was then removed with a full-sized trephine. The moment the elevator had detached the bone a gush of blood took place through the opening, and a clot was discovered beneath. On passing the finger into the cranium it entered an extensive mass of coagulum, which extended in every direction as far as the finger could reach. The interior of the cranium presented, as far as could be felt, no irregularity or trace of fracture. A small quantity of the coagulum was removed with the handle of a teaspoon, and the wound was then covered with lint dipped in water. The deep stertor of his breathing had ceased almost on the instant that the bone was raised, and he was evidently relieved by the operation. During the rest of the day blood continued to ooze from the opening in the skull, but there did not appear to be any active hæmorrhage. Twelve grains of calomel were given in two doses.

September 4th.—He talked incoherently, recognised his wife, and moved his right arm and leg freely. From this date up to September 18th the patient remained in a weak condition, restless, uneasy, and irritable, perfectly sensible when spoken to, but immediately relapsing into a rambling, incoherent state.

19th.—The unfavorable symptoms have increased. Pulse sharp, quick, and irritable, the face flushed. Is with difficulty aroused from his low muttering state. Incessant twitching motions of the muscles of the right arm and leg, and right side of face. The dura mater had risen into the opening of the bone; it was dry and covered with thick secretion. A poultice was applied and in a few hours a free discharge of ill-conditioned pus took place from between the dura mater and the cranium, after which the unfavorable symptoms immediately began to subside.

25th.—Though the patient takes plenty of nourishment there is little effort at restoration in the wounds. The dura mater is dry and raw, like parchment. The patient is listless and disinclined to speak, and when addressed answers indistinctly.

29th.—A remarkable improvement has taken place within the last twenty-four hours. The patient seems to have entirely awoke from the state of apathy and indifference which has hitherto prevailed. He has entirely lost his incoherent manner, his confusion of ideas, and his indistinctness of utterance; he has become, all at once, cheerful and lively, and only complains of hunger. He seems to have little or no recollection of what has occurred.

November 2nd.—The muscular spasm, which has been constant, is now much abated.

December 6th.—He left the hospital, having quite recovered his strength. The original scalp wound is healed, the trephine wound nearly closed.

15th.—Mr. Cock again admitted the patient as he had been much alarmed by a return of the spasmodic twitching of the facial muscles, accompanied by what he describes as a gurgling noise and sensation in his head. After being cupped, and the bowels being freely moved he had no indication of any cerebral mischief.

February 21st, 1842.—The patient called on Mr. Cock to say that he continued quite well, and had resumed his occupation with his former employer.

The following sequel of the case is taken from the 'Guy's Hospital Reports,' for 1857, p. 365:

The patient shortly resumed his work and continued in full employment and in excellent health for thirteen years. Had frequent opportunities of seeing the patient after he left the hospital, and the following memoranda, extracted from my note-book, will serve to continue the case, as recorded in the volume of 'Guy's Hospital Reports' above mentioned,[1] up to the period of the man's death.

May 16th, 1842.—Removed a portion of bone which had exfoliated from the margin of the trephine aperture. Is in perfect health, but says he has occasional pain about the opposite ear, and stiffness of the muscles below the mastoid bone.

June 12th, 1842.—Quite well; the exuberant granulations indicate a further portion of exfoliating bone.

January 31st, 1843.—Extracted a large portion of dead

[1] Vol. vii, 1st ser., p. 157.

bone, about an inch and a half square, including a third of the circumference of the trephine hole. It was the entire thickness of the skull; the under surface unchanged, and marked by the dura-matral vessels.

March 12th, 1843.—Removed two small portions of bone. The wound filling up. A few minute fragments of bone have come away during the last few months.

November 5th, 1843.—The wound cicatrised, with a very thin pellicle of skin; the cicatrix pulsates. His health continues exceedingly good, and he is capable of undergoing great fatigue and exertion.

May 13th, 1849.—I have had frequent opportunities of seeing him during the last few years. He has continued in perfect health, following his employment, going up ladders, &c. He now informs me that a month ago he had a slight "fit," and that yesterday he had three fits, each lasting only a few minutes; that during the fits the right side of the face worked, and that the right hand was firmly closed. The right leg appears to have been little if at all affected. He was purged and cupped in the week with great relief.

August 26th, 1849.—Had a similar attack a few days ago; otherwise in perfect health. Was again cupped.

October 14th, 1849.—Has had epileptic fits this week, affecting the right side. Was dry cupped.

During the next few years he continued to be the subject of occasional epileptic fits at irregular intervals, but still continued his employment, although the attacks became gradually more frequent and more severe in their character. During this period he was accustomed to seek relief from dry cupping.

The last memoranda of this case are from the notes of Sir William Gull, under whose care he was admitted into Guy's Hospital in February, 1855.

He is therein stated to be suffering from partial hemiplegia of the opposite side of the body to that of the injury; the face included in the paralysis, and the speech somewhat affected; also that he had some slight mental confusion. The patient then said that he had of late suffered from epileptic attacks, the fits being at five weeks' to three months' interval, and characterised by much irritability before the seizure, and

almost complete unconsciousness for some hours afterwards. He never had any paralysis till after the last attack, which was six months before his admission into the hospital.

On August 30th, 1856, he was seized with an apoplectic fit and shortly died. A post-mortem examination was made at his house on the following day, by Dr. Wilks, who adds the accompanying report:

The body was that of a stout, strong, healthy-looking man. A scar was seen running from the left side of the forehead to the vertex, but the site of the operation was not observable until a careful search had been made; it could, however, be accurately defined by the finger, which, by being passed over it, could detect the extent of the vacuity in the bone, the hard boundaries which surrounded it, and the soft, elastic, compressible membrane by which it was covered. In order to remove the calvaria it was necessary to leave the portion of scalp which closed the opening on the outside of the bone, and the dura mater which closed it within, so firmly had these membranes become incorporated. Upon cutting through the portion of brain immediately beneath, and which was adherent by its serous covering to the dura mater, a large quantity of semi-coagulated blood fell out, and presently, three or four ounces more issued from the ventricles. The latter, which were full of blood, communicated with the softened brain-structure at this part, and thus the section caused the whole of their contents to escape. This apoplexy, which was the immediate cause of death, by infiltrating all the structures in the neighbourhood of the injury, unfortunately prevented a full knowledge of the exact condition of the parts prior to its occurrence. The principal source of the hæmorrhage had been probably in the left corpus striatum or optic thalamus, for at the right side these bodies were quite healthy, whereas on the left they were reduced to a pulp by the blood which was effused within them; the middle lobe of the hemispheres external to this was in a like condition, even as far as the neighbourhood of the original seat of injury, and therefore, as before said, when the latter part was incised the clots at once made their way from the ventricles. This region of the brain, when the blood was washed away, was no doubt the subject of old disease; the structure was soft and of a light-

brown colour, and from so large a part being filled with blood it was probable that a hollow space had been produced here by the ramollissement, that is, in the middle hemisphere opposite to the hole in the skull, and reaching downwards to the base, and inwards to the ventricles as far as the thalamus, whose surface also appeared to have been involved in the same chronic degenerative process. It appeared probable then that a softening had been going on for some months in the middle hemisphere of the brain, involving the contiguous surfaces of the corpus striatum and thalamus, and that at last a rupture of a vessel had taken place, infiltrating all these diseased structures as well as the ventricles.

The softening which favoured the final hæmorrhage was no doubt due to the state of the blood-vessels, which were found extremely diseased throughout the brain; the patient remaining so many years in good health sufficiently proves that the cause of the softening was to be found in them rather than in the original injury. Why this part of the brain was the principal part of the impaired nutrition need occasion no surprise, since it is well known that injured parts, from the altered circulation or other causes, do often remain permanently weak.

As regarded the original wound it was not replaced by the growth of any new bone, but the trephine opening was filled by a tough membrane composed of the integument on one side and the dura mater on the other. At its upper part were two deep depressions, whence probably the diseased bone had proceeded. Immediately in front of the trephine hole there was a depression in the bone, which extended upwards and downwards for three inches. It was caused by the ridge of new bone immediately in front of it, and might, with some possibility, have been the site of a fracture which took place at the time of the injury; from the great change, however, in the structure of the bone, it was impossible to prove this satisfactorily.

Case 11. *Minute fracture of parietal bone; large extravasation from middle meningeal; exploration without trephining; rapid death; no injury to brain beyond compression.*—Mr. Cock relates ('Guy's Hosp. Rep.,' 1842, vol. vii) this case, which shows, like several others of the cases in this paper, how minute

the fracture may be which causes the rupture of the middle meningeal artery.

A man was brought to the surgery in the morning, in a state of syncope, having, as was reported, fainted in the street. Some stimuli were given to him, under which he speedily rallied and walked away. In the course of the afternoon he was again carried into the hospital, in a state of complete coma with apoplectic stertor. The usual treatment, bleeding, calomel, &c., were resorted to without relieving his symptoms. From the details of the case and the general aspect of the patient Mr. Cock was led to think that he might be suffering from extravasation of blood beneath the cranium. On examining the head a slight bruise was found on the right temple, and Mr. Cock cut down upon the bone in that direction, on the chance of finding a fracture. However, after exploring the angle of the parietal bone no trace of fracture was discoverable, and Mr. Cock did not feel justified in proceeding further. The patient died in the course of a few hours; and on examination a minute fracture, hardly discernible on the exterior of the cranium, was found to traverse the lower extremity of the parietal angle. A large clot of blood had accumulated between the dura mater and the skull, poured out from the ruptured meningeal artery. There was no other injury whatever to the contents of the cranium.

Case 12[1]. *Fracture (from musket ball) of right parietal bone; middle meningeal extravasation; marked interval of consciousness; trephining; death within twenty-four hours of the injury.*—A French artillery driver was knocked off his horse by a musket ball, which struck him on the anterior and inferior portion of the right parietal bone, in a charge made by General Brennier, at the battle of Vimiera, on the British infantry under the command of the late Sir Ronald Fergusson. The charge was as vigorously met, and the French guns were taken on the spot, two of the drivers lying dead by the side of the horses. In this state I found them; the third was struck on the head and also wounded in the leg, which prevented him from running away. He explained the nature of

[1] This and the next two cases are given by Mr. Guthrie, 'Injuries of the Head affecting the Brain,' p. 59.

his case, the manner of the advance, &c., and I took him under my care, thinking, from his freedom from symptoms and the slightness of the fracture, that he probably would do well. The next morning I went into the village to look after some French officers, and found my driver lying under the wall of the church, which had been turned into a hospital, apparently dying. I lost no time in procuring a trephine, and in raising a portion of bone, when a thick coagulum of blood appeared underneath, apparently extending in every direction. Three more pieces of bone were taken away, and the coagulum, which appeared to be an inch in thickness, was removed with the help of a feather, with difficulty. The brain did not, however, regain its level, and the man shortly after died. The middle meningeal artery was torn across on the outside of the dura mater,—the wound did not pass through to the inside. After his death I opened the dura mater, but there was no blood beneath it; the convolutions of the brain were depressed and flattened by the pressure.

Case 13. *Fracture (musket ball) of right parietal bone; middle meningeal extravasation; elevation of fragments and removal of clot; marked improvement; death on third day.*—A soldier of the 29th Regiment was struck on the right parietal bone in a similar manner, shortly after daylight, at the battle of Talavera, during the first attack on the hill, the key of the British position. He walked to me soon afterwards, to the place where the wounded of the evening before had been collected in the rear. Being otherwise employed, I heard his story, but could not attend to him at the moment and found him some time afterwards senseless, with a slow intermitting pulse, breathing loudly and supposed to be dying. The fractured parts were sufficiently broken to admit of the introduction of two elevators, by means of which they were gradually removed, together with a large coagulum of blood which had depressed the brain. When this was removed the brain regained its level, the man opened his eyes, looked around, knew and thanked me. The pulse and breathing became regular, he said he suffered only a little pain in the part and should soon get well. He died, however, on the third day.

Case 14. *Depressed fracture of right parietal bone; middle meningeal extravasation; elevation of bone and removal of coagulum; recovery.*—During the battle of Salamanca a soldier of the 27th Regiment was brought to me, who had walked to the rear, and had fallen down insensible within a few yards of the hospital station. I found a considerable fracture, with depression, at the inferior angle of the parietal bone, before and above the ear. The end of the elevator being introduced a small piece of bone was first raised, then another, and a third, when a thick coagulum was exposed and removed. The dura mater was not separated from the bone around to any extent, and the coagulum, although thick, was not large. The brain, which had been depressed, regained its level immediately, and the man recovered his senses immediately. He was sent to Lisbon cured of his wound, but unfit for service. The artery did not bleed after it had been exposed.

Mr. Guthrie goes on to state that he had two similar cases, both of which recovered, one at the siege of Ciudad Rodrigo, the other at the siege of Badajos; and that he has had others on subsequent occasions, where the brain has been also wounded, in which the result was not always so fortunate.

As he mentions distinctly these latter cases in which middle meningeal hæmorrhage was complicated with brain injury, the writer has placed the three cases 12, 13, 14, in this group; no injury to the brain is mentioned and it is probable that with the missiles of the date of the Peninsular War travelling with low velocity the fractures were localized to the site struck by the bullet, without starring lines travelling into the base and elsewhere.

A better instance of prompt trephining under difficulties than that related in Case 12 will probably not be met with again.

Case 15.[1] *Depressed fracture of frontal and parietal bones; middle meningeal hæmorrhage; trephining; death on the third day; traces of inflammation of pia mater.*—A man was knocked down in Smithfield by a brickbat, thrown at him by some villains against whom he had appeared as evidence upon a trial. He was immediately brought to the hospital, but in a state of

[1] Abernethy, 'Surg. Works,' vol. ii; 'Injuries of the Head, &c.,' p. 42.

profound apoplexy. The right side of the frontal bone and the lower part of the parietal were beaten in, the area of the depressed piece being two inches in diameter. After making three perforations in the circumference I was enabled to remove the depressed portion. I then took out a large handful of coagulated blood, which lay upon the orbitary process of the frontal bone, and had so pressed back the anterior lobe of the brain that I could, with my finger, touch the transverse spinous process of the sphenoid bone. The brain now rose slowly, in consequence, I suppose, of the blood gradually finding its way through the compressed vessels, and the man began to show signs of returning sense. He was bled, and his bowels were emptied by a purge. The next day he was so far recovered as to give an imperfect account of the accident, but on the third day he died convulsed.

On dissection some blood was found between the dura and pia mater, and traces of inflammation appeared on the latter membrane.

Remarks.—This and the next case are placed in this group owing to the probability that blows with a brickbat or poker on the side of the skull would cause localized injury to the bones here, not extending into the base. The deficient account of the post-mortem, however, renders this doubtful.

Case 16.[1] *Ruptured middle meningeal artery; paralysis of motion and sensation; no operation; death on the eighth day.*—A man, æt. 30, had a fracture of the left parietal bone, caused by a poker. This led to the effusion of a large clot of blood on the dura mater compressing the brain. When admitted into Guy's he was almost in an unconscious state, with contraction of the pupils (particularly the right), and was very restless. Two days afterwards, although he had not spoken, he seemed to have some degree of consciousness, and it was found that he had loss of motion and sensation in the right arm and leg, and particularly in the former. Two days afterwards he had somewhat recovered from his lethargic state, and appeared to feel when he was touched. After this

[1] The above case is taken from Dr. Wilks's 'Diseases of the Nervous System,' p. 37.

he again became comatose, and gradually sank on the eighth day.

Remarks.—The return of partial consciousness two days after the injury points to some power of the brain to accommodate itself to the intruding blood. The return of coma may be explained by the fact already alluded to, that the hæmorrhage in these cases may be repeated. The duration of life without any operation up to the eighth day is unusual, and the case may be compared on this point with one under the care of Mr. Hutchinson, Case 31, p. 211, in which life was prolonged to the ninth day, and one under Mr. Cooper Forster in which death did not ensue till the eleventh day.

Case 17[1].—*Fracture of right side of skull not extending into base; rupture of posterior branch of middle meningeal artery; slight ecchymosis and contusion of brain; trephining; death within a few hours after injury.*—A boy, æt. 10, walked home after a fall upon the pavement, gave a clear account of the accident, and complained of pain on the back of the head; he then vomited, wandered in his talk, and became drowsy. Some six hours after he was brought to University College Hospital, the drowsiness increasing, though he was able to stand up and answer questions. There was no wound, but a large hæmatoma above the right ear. The movements of the left arm and leg were weak. Soon after admission his pupils became unequal, the right being larger. At first he took notice when spoken to, but soon became rapidly insensible, with convulsive movements in the limbs, more especially the right side. The respirations were catchy and short; he yawned at intervals and grew rapidly weaker. Trephining was performed over the right middle meningeal artery, and a large clot was discovered near the wound. Chloroform seemed to alter the already failing respiration so much for the worse that the operation was completed without an anæsthetic. Artificial respiration also was required; the pulse grew gradually weaker and the boy died.

Post-mortem examination.—A fracture of the skull was found on the right side, extending horizontally forwards from

[1] Reported by Mr. Godlee, 'Med. Times and Gaz.,' Nov. 1, 1884; 'Annals of Surgery,' vol. i, No. 3, p. 278.

the junction of the lower and middle fourths of the lambdoid suture to one inch behind the temporal suture; beneath was a large disc-shaped clot, depressing the brain. The posterior branch of the middle meningeal was torn through where the fracture crossed it. Water injected through the carotid in the neck demonstrated the exact opening in the meningeal, which was apparently plugged by a small clot. There was considerable flattening of the convolutions beneath the clot, and also of the convolutions of the entire brain. There was ecchymosis of the pia mater over the left frontal lobe; both the grey and white matter were disorganised in a small area above the frontal lobe.

The points to note in the diagnosis were:

1. An interval of consciousness after the head injury.
2. The gradual onset of drowsiness, with vomiting.
3. The drowsiness passing into unconsciousness.
4. The paresis of one side of the body.
5. The slow pulse.
6. The slow respirations.

It seemed probable that the convulsions were more marked on the right side because of the paralysis of the left.

The seat of rupture in the vessel was demonstrated, after death, to be situated vertically above the mastoid process, and one and half inches behind the centre of the trephine hole, but there was nothing to point out more exactly the position of the lesion. Mr. Godlee concluded that operations should be performed in these cases without the aid of an anæsthetic.

Case 18.[1]—*Depressed fracture of parietal bones; double middle meningeal hæmorrhage; trephining on the fourth and seventh day; recovery.*—R. R—, a young man, February 24th, 1750, fell backwards from his horse on a rock. His foot sticking in the stirrup, he was dragged some way till the girth broke, and left him with his head between two stones in a rill of water, where he would soon have been suffocated had not a shepherd boy drawn him out.

A large piece of the left parietal was driven in, backward, to

[1] This and the next case are taken from 'Cases in Surgery,' by J. Hill, surgeon in Dumfries, p. 94, Edin., 1772.

the lambdoid suture, with a fissure in the right parietal forward, bent like a shepherd's crook, the whole being nearly the length of that bone.

His friends positively refused to allow the skull to be perforated till four days after the accident, though the stupor, profound sleep, and other bad symptoms showed to demonstration that there was no other possible means of saving him.

With the smallest head of the trepan I opened the skull about half an inch before the fissure.

The dura mater was so far torn from the skull that two or three ounces of blood were lodged between them, the discharge of which relieved him so considerably that his friends flattered themselves that there would be no occasion for operating any further, and opposed the examination of the other side three days longer, when the prospect of immediate death obliged them to consent.

By this time there was a firm circumscribed tumour, about the thickness of one's finger, all along the fissure, owing to extravasated blood within the skull, and betwixt the skull and pericranium. When the blood was discharged by piercing that membrane the fracture was discovered to be wide enough to allow a free passage from within. Upon seeing this I took off only so much of the teguments as to prevent their healing too soon. He recovered in five weeks, and he continues well in 1771, married, and has a family.

Case 19. *Blows on head; middle meningeal extravasation on both sides; trephinings; recovery.*—J. R—, about 30, received, February 27th, 1751, blows on the head with a loaded whip-handle, and a crab stick. Next morning he was in a profound apoplectic-like lethargy, and his whole right side was paralytic, though there was neither fracture nor depression.

The symptoms showed the necessity of opening both sides of the head. But the impressions of the staff being strongest on the right side, it was opened first, though the symptoms generally indicate the contrary.

The pericranium adhered firmly on the outside, but the dura mater was detached so far within, as to contain at least six or seven ounces of fluid blood betwixt it and the skull.

the junction of the lower and middle fourths of the lambdoid suture to one inch behind the temporal suture; beneath was a large disc-shaped clot, depressing the brain. The posterior branch of the middle meningeal was torn through where the fracture crossed it. Water injected through the carotid in the neck demonstrated the exact opening in the meningeal, which was apparently plugged by a small clot. There was considerable flattening of the convolutions beneath the clot, and also of the convolutions of the entire brain. There was ecchymosis of the pia mater over the left frontal lobe; both the grey and white matter were disorganised in a small area above the frontal lobe.

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2. The gradual onset of drowsiness, with vomiting.
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It seemed probable that the convulsions were more marked on the right side because of the paralysis of the left.

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The symptoms showed the necessity of opening both sides of the head. But the impressions of the staff being strongest on the right side, it was opened first, though the symptoms generally indicate the contrary.

The pericranium adhered firmly on the outside, but the dura mater was detached so far within, as to contain at least six or seven ounces of fluid blood betwixt it and the skull.

After the blood was discharged we saw a small artery open on the surface of the dura mater, throwing out blood *per saltum*, which in a little time stopped of its own accord, and never gave us more trouble. The whole quantity of blood discharged was about eight or nine ounces.

This gave him some relief. But his friends would not allow the other side to be opened till four days after, when all hopes of life seemed to have gone, and he was left to die among our hands.

The left parietal bone was then opened. The whole hemisphere of the brain was most surprisingly compressed by a black cake, which at first sight Dr. Gilchrist and I imagined to be the dura mater mortified, till by touching, we discovered it to be coagulated blood, of the colour and consistence of black-currant jelly, which had insinuated itself betwixt the dura mater and skull from the falx at top to the bottom of the os petrosum. It was above an inch thick, and consisted of about as many ounces as had been discharged from the other side.

It was not thought safe to bring away the whole mass at once. But on taking out a few ounces of it and speaking to him he instantly looked up, like one awakened from sleep, knew and named everybody, and raised his arms, which had been paralytic, over his head.

More of this cake being daily taken out, he recovered so fast that in fifteen days after the injury he walked into the next room three days successively, and sat up some hours each time. But the dressings unhappily slipped off one night when he was asleep, and a small artery in the scalp, which had formerly given us no trouble, sprung and bled so excessively before I could reach him, being three miles distant, that he fainted for some minutes. The loss of blood made the confusion of his head return, with a quick, small pulse, &c.

Some days after, his friends, despairing of his life, carried him home on a litter, eight miles, without acquainting me of their design. After this I saw him three or six times and taught the people how to dress him.

While at home the left side of his brain suppurated five or six times at small intervals, accompanied each time with a fever and such a stupor that he could not swallow anything

without great difficulty, till the matter got vent and then he swallowed with ease.

I did not examine how far the dura mater was disengaged from the skull on the right side because the blood flowed freely out. However, its extent could not be much less than on the left, into which, when taking out the coagulated blood, I introduced a crooked probe, at the perforation of the trepan, three inches downwards towards the os temporis, till it was stopped by the curvature of the os temporis. Then I moved it round by the lambdoid suture, the falx, and below the os frontis, to the bottom again, without any opposition. So completely was every vessel and fibre broken on that whole side, and that as well at the sutura squamosa and coronalis as at the other parts of the cranium.

So many vessels torn asunder on both sides of the head occasioned such a large discharge of matter that it was three months before he recovered.

He is in good health 1771, and has had several children since. He is sometimes liable to convulsive twitchings, but they do not deprive him of his senses, and his memory at times fails him so far as to make him at a loss for words to express himself.

Case 20.[1] *Middle meningeal extravasation; concussion symptoms for three hours, then recovered from; onset, later, of compression symptoms and death within nineteen hours of the accident.*—A child was playing on a table, from which it fell on a stone floor, receiving a severe blow on the head which caused concussion of the brain; the child appeared to recover at four in the afternoon, the time at which the accident occurred being one; pain still continued in the head, the child cried considerably; it went to bed about two hours before its usual time; during the night the servant was awoke by the apoplectic stertor of the child, which prevented her from sleeping; when she moved it, the child was not roused; she discovered that it was ill, alarmed the family, and at eight in the morning it died.

It was found after death that a considerable quantity of blood was extravasated on the brain.

[1] Sir A. Cooper, 'Lectures on Surgery,' p. 125.

Case 21.[1] *Extensive and depressed fracture of parietal bone; middle meningeal hæmorrhage; trephining three days after the accident; recovery.*—M. C.—æt. 14, was admitted into the South Devon and East Cornwall Hospital, under the care of Mr. Swain, on September 9th, having on that morning fallen from a verandah two stories high, pitching on her head on the kerbstone; she was picked up insensible.

On admission she was perfectly unconscious, but constantly moaning. Over the left parietal bone there was a large fluctuating swelling, through which the edge of the bone could be distinctly felt. There was no external wound; the left eyelid was puffy and slightly discoloured. There was no paralysis; respiration was normal; the pupils were dilated but normal; there was no vomiting; her head was shaved and ice applied.

On September 11th she was in much the same condition; the temperature had fallen from 100·2° to normal.

On the 12th the right pupil was dilated and the left contracted. The temperature was rising, and the coma was deeper. Mr. Swain determined to make an exploratory incision. An extensive crucial incision was made over the parietal swelling, and a large quantity of blood-clot removed. There was then found to exist a very extensive fracture of the parietal bone. The posterior part of the bone was jammed down on the dura mater. A large oblong portion was quite separated from the surrounding bone, and deeply depressed. Some portions of bone having been removed with the bone forceps, room was made for the insertion of the elevator, when the parietal bone was lifted into position, considerable force being required to accomplish it. The loose portion of bone was then elevated and removed entirely. There was no wound of the dura mater, but a large clot was found between it and the skull, this was removed; considerable hæmorrhage took place from the surface of the dura mater, and was only arrested by the use of the actual cautery. The wound was then syringed out with carbolic lotion, and the skin carefully adjusted and sewn together with numerous carbolized catgut ligatures. A drainage-tube was inserted, and the whole dressed antiseptically.

[1] 'Brit. Med. Journ.,' Dec. 12th, 1885, from notes by Mr. Buchan, the house surgeon.

On the 14th she was more sensible; the pupils were equal and slightly responsive to light. The temperature was normal.

On the 19th she for the first time recovered her speech; she talked with the nurse and quite understood what was said to her. The wound was now healed.

On November 14th.—The patient was quite well, with the exception of slight frontal headache.

Remarks.—It is possible that the absence of paralysis in this case may have been due to the fact that the blood as it was effused was able to escape, in part, externally beneath the scalp, owing to the extensive fracture. The means by which the hæmorrhage was arrested, after the removal of the clot, is interesting.

Case 22.[1] *Fracture of internal table only; middle meningeal hæmorrhage; general paralysis; death ten hours after the accident.*—On November 20th, 1881, Mr. Bryant was called by Mr. W. Blasson, of Edgware, to see Mr.—, about 40 years of age, who after a day's hunting, while riding into Edgware at a quiet pace came into collision with a hay-cart, and was seen to fall sideways off his horse upon his head.

The accident was witnessed by a medical man who was near and went to his assistance. When picked up the patient was perfectly unconscious, comatose, with stertorous breathing. He was put to bed in an inn near the place of accident, and when Mr. Blasson saw him, within an hour, he found him as described with marks of bruising on the left side of his head, but with no distinct evidence of fracture. Seven hours later, as no change took place, Mr. Bryant was sent for. He found the patient perfectly unconscious and comatose, breathing stertorously, the pupils dilated and fixed, skin warm, pulse slow and of moderate calibre. All the limbs were completely paralysed. There was bruising over the left temporal region, but no signs of fracture. The urine was drawn off and an exploratory incision made over the seat of injury, down to the bone, but as no fracture could be detected, it was not thought right to trephine, the paralysis being general. The gentle-

[1] The writer is entirely indebted for the notes of this case to Mr. Bryant.

man died about two hours later, and about ten hours after the accident.

Post-mortem examination.—Mr. Blasson found no indication of fracture visible on the outside of the skull. On removing the calvaria, which was thin and translucent, a large clot of blood was found between the bone and dura mater on the left side, and on careful examination of the bone, a fissure, which involved only the internal plate of the parietal, was found to have divided a main branch of the middle meningeal artery. There was no injury to the brain.

Mr. Bryant considers that the fact that the paralysis was general may be explained by the clot on the left side of the brain, large and rapidly effused, having made urgent pressure, through the left side of the brain, upon the right as well. See also the remarks under the head of symptoms at p. 270.

This case may be compared with No. 1 and No. 4 and with the two following, as in all the internal table alone was fractured. All impress the fact how very little external evidence there may be of the very grave lesion which lies beneath the bone which is, apparently, injured so trivially.

Case 23.[1] *Fracture of internal table only; middle meningeal hæmorrhage; trephining; relief to compression symptoms; death some days later from suppuration and meningitis.*—A young woman was thrown out of a country waggon upon a pavement, and said to have pitched upon her head. She was instantly deprived of sense and brought to the hospital in that state. Her head was immediately shaved and examined but found to be so absolutely free from all mark of violence that I was in doubt of the truth of the account given of her. She was freely let blood, and some medicine directed to be got down in order to empty her. The next day she was in the same state. More blood was drawn off and her cathartic repeated. The third day, she being exactly the same, both the temporal arteries were opened. On the fourth, there being no alteration, I determined to apply a trephine on that part of her head on which she was said to have fallen, and which, when pressed hard, seemed to produce such motion in her as if it gave some pain.

[1] 'The Chirurgical Works of Percivall Pott,' vol. i, pp. 266—270.

In a case of less necessity this would hardly have been an authority, but here something was to be attempted. I removed a large piece of scalp, and found the pericranium, though not detached absolutely, yet not naturally or firmly adherent. I applied the trephine, and when I had worked a few seconds I took out the instrument to clean it, but was much surprised to find in it a piece of the upper table of the skull. I put in my finger to feel what was underneath and found that it touched the remaining table, which receded from the finger, and returned again upon removing it; and when I pressed the said loose piece hard, the girl's whole frame was spasmodically agitated. What was to be done? It appeared to me that if all her symptoms were not caused by the pressure of the loose piece, yet they were certainly aggravated by it, that therefore it must be taken away at all events, and that it was much too large to be extracted at the present opening, besides which as it ran upwards towards the sinus I should not have chosen to run the risk of a hæmorrhage from thence while the sinus was covered with bone. I perforated all round the present opening with a small trephine in such manner that each perforation so bordered on the other as that the whole should make one opening.

For nearly one half of the circle the outer table only came away in the instrument, leaving the inner loose and covered with blood, but in all the lower part the trephine went through both tables and left the dura mater covered with grumous blood also. When the circle was finished the loose portion was easily taken away; its upper part made a part of the sagittal suture, but no blood followed its separation. The dura mater under the whole was thinly covered with grumous blood.

Next day she retained her urine, and opened her eyes. In two more she recovered her speech and became as rational as I suppose she ever had been, and would in all probability have done well, as far as regarded the evils produced by nerve-pressure, but after some days matter formed between the detached dura mater and the skull, and the symptomatic fever usually accompanying such mischief came on with such rapidity that all the efforts of art were vain.

Case 24. *Fracture of internal table only; middle meningeal hæmorrhage; death within forty-eight hours.*—A porter at work at the waterside was knocked down by a blow from an iron hook at the end of the tackle belonging to a crane. He was senseless for nearly half an hour, but after that was so well as to walk home. The next morning he lost his sight, and by the evening his speech and faculty of walking. In this state he was brought to the hospital. He was largely let blood and thoroughly emptied; and I intended, if these evacuations did not materially serve him, to have examined the state of that part of the bone whereon the blow was received, but that night he died.

Upon examining his head a piece of the inner table of the os parietale, of about an inch and a half in length, and not quite so broad, was found detached from the outer table, having a quantity of blood both between them and on the surface of the dura mater.

These are the only instances which I have met with of fracture of the internal table alone, though I make no doubt that some of those who have been said and thought to have been destroyed by concussion have sunk under this kind of mischief.

Case 25.[1] *Small linear fracture of skull, not involving base; middle meningeal hæmorrhage; death within ten hours; injury to brain slight.*—J. A—, æt. 36, was brought to the surgery at Guy's Hospital at 12.30 midnight, February 17, 1882. Mr. Stephens, examining him as dresser for the week, found him drunk with a scalp wound an inch and a half long situated about two inches above the external auditory meatus; there was also a swelling over an area of about three inches resembling a bruise caused by striking the head sharply against a stone. No bare bone was to be felt with a probe, nor with the little finger, which passed upwards for about half an inch beneath the scalp.

[1] The writer is indebted for this case to Mr. Symonds, who was asked to look at the patient in the surgery while visiting the hospital for the purpose of operating on a case of emergency. There was nothing at this time to indicate anything serious in the patient's condition, and Mr. Symonds had no opportunity given him of seeing the man again.

The patient was said to have been knocked down by a cab.

When spoken to he answered rationally; pupils equal, not contracted nor dilated; hearing good; no subconjunctival ecchymosis; no paralysis, the patient being able to walk from the surgery with a policeman to a cab after having his head dressed.

At 4 a.m. the patient was again brought by the police to the surgery on a stretcher; he was now breathing stertorously, with mucous foam at the mouth, loud rattling in the throat, pulse slow and full. Whilst being lifted into bed he almost ceased breathing; artificial respiration was performed, mucus expressed, and the breathing became better.

At 7 a.m. there was some twitching of his hands and the patient began to breathe more slowly and to foam at the mouth.

8.55 a.m.—Death took place quietly.[1]

Post-mortem examination.—A scalp wound on the right side of the head. Behind it was a small linear fracture about two inches in length. This cut across the posterior division of the meningeal artery (a bristle showed the site of the laceration in it) and a large cake of clot lay outside the dura mater, flattening that side of the brain.

There was a little bruising of the under surface of the left middle lobe.

Case 26.[2] *Extensive fracture of left side of skull not involving base; middle meningeal extravasation on this, and, to a less degree, on right side; trephining; partial relief; death with pneumonia; no injury to brain.*—During a drunken affray in a liquor shop the patient was knocked down by a blow on the head with a heavy stick. He fell down insensible, but recovered consciousness after a while, and was able to speak, but soon relapsed into a state of insensibility, in which condition he was taken to the dispensary next morning and placed in bed. When seen the man was unconscious and very restless, tossing about the bed; he made no response to questions. His pupils were normal, the breathing was at

[1] The notes of the case have been furnished by Mr. Stephens.

[2] Dr. G. C. Roy, 'Lancet,' ii, 1884, p. 318.

times natural, with a tendency to stridor. Pulse 72, small. There was no paralysis, but the limbs were rather rigidly flexed. The scalp at the junction of the sagitto-coronal suture was contused and puffy, and a depression was felt in the skull just outside this line and to the left. A crucial incision was made over the part, and a trephine applied over the depressed segment. A linear line of fracture traversed this space, but the depression was limited to the outer table, and was caused by the condensation of the bone from the force of the blow. A probe was gently passed between the bone and dura mater to scoop out any blood that might have been effused on its surface, but only a few small pieces of clot could be thus removed. The wound was dressed with cotton soaked in weak carbolic acid.

Next day there was a return of consciousness. The patient opened his eyes when spoken to loudly. He also put out his tongue, and pointed to his head as the seat of pain. He was, however, very dull and stupid and could not speak. The progress was impeded next day by an attack of erysipelas, which travelled from head to face and neck, and after three days left him in a very exhausted condition. For the next three days the patient's condition was hopeful. The wound was granulating, and he could answer questions by signs, though still unable to speak. He took a fair quantity of rice and milk. The rigidity of the limbs disappeared, but the pulse went up to 116, and a tendency to pneumonia of the left lung was manifested. On the ninth day after operation he was decidedly worse, the consolidation of the lung had progressed, and he died quietly at night.

Post-mortem examination.—The extensive fracture passed across the left squamous bone, and bifurcated at the external angle of the orbit, enclosing a bit of loose spiculum. Another line of fracture radiated upwards from the centre of the first, and terminated at the seat of operation. A thick layer of coagulated blood rested on the dura mater, just opposite the temple, measuring $5 \times 3 \times 1$ inch. At the lower part it was an inch thick and adherent, but gradually thinned on the top. Another patch of coagulated blood was found on the right side opposite to the parietal eminence. The dura mater and brain were healthy. The left lung was in the first stage of

hepatisation. Other organs were healthy. Wound healthy looking.

Remarks.—In the middle meningeal extravasation on both sides, and the violence, with a heavy stick, this case bears a close resemblance to No. 19 at p. 187. The absence of any "paralysis" is difficult to explain. The fact that so much clot was left after a simple trephining, *i. e.* removing one circle of bone without further removal by Hoffman's forceps, &c., bears on the question treated of at p. 173, and again under the head of treatment at p. 303, *i. e.* which is the safest course for the patient, to remove only a circle of bone which, it is hoped, shall act as a safety-valve against recurrence of pressure, or to remove the bone more extensively to admit of a complete removal of the clot.

The death of the patient, nine days after the operation, of pneumonia, may be compared with the same ending in Case 30, p. 208. The occurrence of pneumonia is common to all severe injuries of the head.[1]

Case 27.[2] *Fracture of side and base of skull; hæmorrhage between bone and dura mater, probably from middle meningeal; trephining; relief from compression symptoms; death with hyperpyrexia about thirty-six hours after injury; no injury to brain.*—J. R—, æt. 7, was admitted into University College Hospital, under Mr. Beck, at 2 p.m., July 13th, 1877. An hour before he had fallen from the top of a wall about eight feet high; had since not been thoroughly sensible, and was very much inclined to sleep. He was brought to the hospital to have his arm set, no complaint being made of his head. When first seen the boy told the dresser what was the matter, but so rapidly became unconscious, that when seen by the house surgeon some five minutes after, no answer could be

[1] This fact is only too well known to all hospital surgeons. Mr. Hutchinson ('Clin. Surg.,' vol. i, p. 77) reports a most interesting case in which this lung complication received a special explanation. The man died of fractured base, followed by inflammation of the subarachnoid spaces at the base of the brain, in consequence of which the roots of the pneumogastric nerves were surrounded with inflammatory deposit.

[2] This and the next case were published by Mr. Beck, 'Med. Times and Gazette,' 1877, vol. ii, p. 199. The first case there given by Mr. Beck is given in this paper at p. 220, being taken from Mr. Erichsen's lecture, loc. supr. cit.

got out of him, though the patient cried and was very irritable when disturbed, or when the injured arm was touched. Right pupil closely contracted, the left somewhat dilated and insensible. Pulse 60, rather soft; in left temporal fossa, just above the zygoma, there was a distinct puffy swelling, and the left eye was more prominent than the right. No bruises or depressions could be felt anywhere else. There had been bleeding from the nose, none from the ear. Bones of left arm fractured about an inch from lower end, with angular deformity, reduction not attempted.

2 p.m.—Mr. Beck saw the case, but did not think symptoms sufficiently urgent to require interference, as the child struggled and cried when touched. Orders were given to watch it carefully, and if the symptoms increased and coma supervened, to send at once for the surgeon.

3 p.m.—Patient breathing more rapidly, almost entirely insensible, but moves his limbs.

3.40. p.m.—Patient is somewhat cyanosed and breathes at long intervals, respiration seeming obstructed by mucus; coma complete, pupils widely dilated and immovable.

3.55 p.m.—When Mr. Beck saw the case breathing had become much more infrequent, patient being once taken for dead, and the sheet thrown over his face. However, he gave a gasp after an interval of quite half a minute; artificial respiration was immediately resorted to and he came round. He was immediately carried into the theatre, and the operation commenced. The swelling on the left temporal fossa, which by this time had become much larger, was cut into, and the bone bared, when blood was seen issuing from a small hole (vein), but no fracture. A crown of bone being taken away over the middle meningeal the anterior edge of a clot was seen. Bone being removed with bone forceps from the back of the trephine hole more clots were exposed. The finger now discovered a large clot between dura mater and bone. This was removed with a small lithotomy scoop, when violent hæmorrhage took place, but no distinct bleeding point could be discovered. During this time artificial respiration had to be resorted to at intervals, but as the brain filled up the place occupied by clot, the breathing became regular and the pulse rapid. The patient was now propped up in the sitting position, and ice applied to

the side of the face, neck, and head; the bleeding beginning to cease in great measure, two or three stitches were put into the lips of the incision, a carbolized sponge lightly bandaged on, and an ice-bag applied. Just before leaving the theatre several futile attempts were made to vomit, and the limbs were freely moved. The right pupil was again contracted and immovable, the left unaltered.

5 p.m.—Patient has taken two feeders of milk, and smacked his lips as if conscious of the drink. Movement of limbs frequent, and easily excited by pinching. Once it appeared that patient tried to speak.

7 p.m.—Temp. 100·6°. Condition unchanged, except that breathing has become somewhat more rapid.

10 p.m.—Resp. 60 per minute; pulse 170. Both pupils immovable.

July 14th (1 a.m.)—Temp. 106° in axilla; profuse perspiration; patient cannot swallow; resp. 78, irregular, not stertorous; no voluntary motion of limbs, but reflex of eyelids good; pulse 180, irregular, both pupils immovable, right dilated three quarters, the left three fifths.

1.45.—Temp. 105·8°.

3 a.m.—Death took place quietly, breathing becoming more and more irregular. Temp. at 2.30 106·4°, and at five minutes after death it had risen to 108·4°.

Post-mortem examination.—On removal of skull some remains of clot were found on left side behind trephine aperture, and the dura mater was separated to the level of the tentorium, and as far back as the occipital bone; no arterial branch wounded. A fissured fracture was found passing vertically downwards, rather behind middle of left parietal bone, and about half an inch behind trephine hole, then passing forwards and separating temporal from parietal bone, it entered great wing of sphenoid, and then across sphenoid; no depression anywhere, the brain seemed perfectly healthy, no flattening of convolutions or other signs of pressure, and nothing to account for death found on section. Left ulna was found fractured about two inches from lower end, and the lower epiphysis of left radius was separated.[1]

[1] Remarks by Mr. Beck relating to this case will be found appended to the next (p. 203).

Group B.—Less hopeful cases for trephining. Violence greater than in Group A. Laceration of middle meningeal artery, one or more of its branches more frequently than the trunk. Fracture of skull always present and no longer slight and localized to side of skull, but extending into base, *i.e.* middle fossa. Compression of brain and contusion also, but this latter trivial.

Here the extravasation is complicated by fracture of the base extending into the middle fossa. Without, for a moment desiring in any way to minimise or speak lightly of this serious complication, it may be pointed out that the extension into the base is usually a mere fissure, and single, and that if the primary brain shock and jarring are recovered from, the co-existing brain contusion is usually slight and trivial and may be recovered from also, if the more urgent and ominous meningeal extravasation is dealt with by trephining, though the surgeon may feel certain that the fracture is not limited to the vault. Cases such as that of Mr. Hutchinson's, No. 31, p. 211, in which a patient with middle meningeal extravasation and fracture of vault and base survives till the ninth day, death then taking place from erysipelas and pyæmia, no hemiplegia having been present after the second day, and one of the writer's, No. 30, p. 208, in which death took place, on the seventh day after trephining, from lung complications in a man of sixty-one, show, it seems to him, the truth of the above remarks.

A surgeon might, at first sight, seem justified in declining to trephine in a case of meningeal extravasation complicated with fractured base; this, however, is a mistake (cf. the remarks on treatment, p. 302), though as Case 29, p. 206, shows, it is a mistake into which the writer has fallen himself.

Case 28.[1] *Extensive fissured fracture of middle fossa of skull; middle meningeal hæmorrhage; trephining; compression relieved but recurrent; death; injury to brain slight and superficial.*—L. C—, æt. 25, having fallen from the height of about eight or nine feet into a stable yard, was admitted into University College Hospital August 15th, 1877, about a quarter of an hour after the accident, under the care of Mr. Beck. She

[1] 'Med. Times and Gaz.,' loc. supr. cit.

was conscious, and related how the accident happened. Both pupils equal and contracted. Pulse 64. She was bleeding freely from a wound on the right side of the head, a little below the parietal eminence. While being examined she complained of being unable to sit up, and lay back on the couch. After this she rapidly became unconscious, and the pulse gradually fell to 42. About a quarter of an hour later the right pupil became widely dilated and insensible to light. The left was of moderate size and reacted feebly to light. She was seen by Mr. Beck about two hours after the accident. Patient unconscious, but moved her arms and legs feebly when disturbed. No definite signs of paralysis. If left to herself she lay absolutely motionless. Breathing stertorous and irregular, occasionally ceasing for an interval of ten or fifteen seconds. In this respect she was rapidly getting worse. Right pupil widely dilated and insensible to light. Left slightly dilated, acting very feebly, if at all, to light. The right eyeball was prominent and the lids discoloured. No blood was showing beneath the conjunctiva. A little blood had trickled from the nose. No bleeding from the ear; just below the right parietal eminence was a small irregular T-shaped wound, greatly contused. A very slight depression could be felt in the bone at this point. No fissure could be detected. No particular fulness in right temporal fossa. The wound was enlarged forwards and the bone examined. A small dent was found in the bone at the point struck, but a fissure was not found. The wound was then enlarged still more forwards so as to expose the bone more in the direction of the branches of the middle meningeal artery. As the patient was evidently dying a large trephine was applied immediately in front of and below the slight dent. When the operation was commenced the pulse was 42, slow and laboured. On removing the piece of bone the dura mater was seen at the upper part; but at the lower part of the opening was a dark mass of clot which bulged up into the wound. The finger passed downwards in the clot as far as it could reach. The clots were then removed, as far as possible, by means of a small lithotomy scoop. This was followed by very profuse hæmorrhage, the source of which could not be seen nor felt with the finger. The patient was immediately raised into the sitting posture and an ice-bag

applied over the side of the head and face. In a short time the bleeding ceased, but the space from which the clots had been removed with the lithotomy scoop became rapidly filled again with soft coagulated blood. The immediate effect of the operation was to raise the pulse from 42 to 72, and the breathing improved. The left pupil contracted somewhat and acted more readily to light. The right pupil did not alter at first. After waiting a little time the symptoms of compression began slowly to return. The pulse fell to below 60, and the left pupil again became slightly dilated. The lithotomy scoop was therefore again applied with considerable relief to the symptoms. Lint soaked in carbolic oil was then laid lightly over the wound. The grave symptoms of compression did not again return, and at 4 a.m. the pulse was about 70, and the left pupil moderately contracted and acting to light. The breathing was laboured, but not stertorous. About an hour after, a large mass of clot which protruded from the wound was pulled away, but it was not necessary again to use the lithotomy scoop.

At 10 a.m. she was quite unconscious, very restless, so that she had to be watched to prevent her falling out of bed. Pulse 75. Pupils nearly equal; blood had appeared under the right conjunctiva. Respiration very laboured; much mucus in the pharynx and bronchi; occasional moaning.

2.45 p.m.—Pupils equal and normal in size. Pulse 120; temp. 103°; resp. 36.

5 p.m.—Temp. 103·6°; respiration worse.

At 8 p.m. she died. Temperature at death 103°. There was no paralysis or dilatation of the pupils before death. She seemed to die rather from asphyxia than coma.

Post-mortem examination.—The trephine was found to have been applied in the anterior and lower part of the parietal bone. Two large branches of the middle meningeal crossed the piece of bone removed. This was rather above and behind the position of the chief branch of the middle meningeal artery. Immediately behind the trephine hole was found the commencement of an extensive fissured fracture. The main fissure ran through the great wing of the sphenoid between the foramen ovale and the foramen rotundum, and crossed the sella turcica, terminating close to the groove for the left carotid.

The sphenoidal sinus was full of blood. From this a fissure ran at right angles through the orbital surface of the great wing of the sphenoid, and opposite this fissure somewhat abundant hæmorrhage had occurred into the fat of the orbit. Thus the bleeding from the nose and the subconjunctival ecchymosis which had been supposed to indicate a fissure running through the orbital plate of the frontal and the cribriform plate of the ethmoid, was in reality due to these two fissures, both belonging to the middle fossa of the skull. From the point struck a short fissure passed downwards and backwards into the squamous portion of the temporal bone, and another connected this with the first fissure, so that a large triangular piece of bone was loose. The coronal, lambdoidal, and sagittal sutures were firmly united by bone. The clot between the dura mater and bone was found to have filled the whole middle fossa of the right side of the skull from the sphenoidal fissure in front to the petrous portion of the temporal bone behind. Inwards it extended to the three foramina in the great wing of the sphenoid. The amount of clot found was not great. It was no more than one third of an inch in thickness. It was firm and adhered to the dura mater. The large anterior branch of the middle meningeal was found to be completely torn across. As is so commonly the case, just before reaching the anterior and inferior angle of the parietal bone it lay in a long canal. It seemed to have been torn across just at its exit from this, almost an inch below the trephine hole. The dura mater was uninjured. On the left side, almost exactly opposite the part struck, were three small superficial lacerations on the temporo-sphenoidal tube. From these a very small quantity of blood had escaped into the cavity of the arachnoid. In other respects the brain was perfectly healthy. It scarcely showed any perceptible flattening opposite the seat of the clot.[1] Marked hypostatic congestion of the posterior parts of lungs. Bronchial tubes choked with frothy mucus.

Remarks by Mr. Beck on this and the preceding case.—In each case consciousness was not lost immediately after the injury, for in the first the child was brought to the hospital

[1] With this may be compared the condition of the brain in the writer's second case, No. 30, seven days after the trephining.

for its broken arm, without suspicion of any serious head injury, and in the second, the patient described the nature of the accident after admission. In each case consciousness was lost, and symptoms of compression set in within a very short time of the accident. This, of course, could only arise from hæmorrhage, as no inflammatory exudation could possibly occur in so short a time. Such abundant hæmorrhage could only arise from laceration of brain-substance, or from the vessels of the dura mater. As in neither of these cases was there any depressed fracture which could have caused direct laceration of the brain, the hæmorrhage, if from laceration, would have been seated exactly opposite the point struck, and the paralysis would have appeared first on the same side as the external injury. In both cases the pupil became dilated first on the same side as the external injury, but there was no hemiplegia. The post-mortem showed that in both these cases dilatation of the pupil was due to direct pressure of the blood-clot upon the nerves as they enter the sphenoidal fissure. In both these also the same pressure acting on the cavernous sinus led to distension of the veins of the orbit and consequent prominence of the eyeball. In one this was increased by slight hæmorrhage into the orbit. The interval of consciousness would also negative any idea of the hæmorrhage being due to laceration, for such an amount of tearing of the brain-substance as would be required to yield such abundant hæmorrhage must of necessity be accompanied by prolonged loss of consciousness. In one case marked fulness of the temporal fossa served as a valuable aid to diagnosis. Trephining was evidently the only chance of saving the patients' lives. Both were on the verge of death when operated upon, and the urgency of the symptoms was still increasing. The situation chosen for applying the trephine was over the course of the great anterior branch of the middle meningeal artery. In the case of the woman it was applied a little higher to avoid making a fresh wound. It would doubtless have been better to apply it lower down, as the clot would have been more easily removed. As soon as the operation was completed the same result followed in each case. The clot was scooped out, and was immediately followed by a deluge of blood, so great as to give rise to a fear that the patient had been relieved of

DESCRIPTION OF PLATES IV AND IVA,

Illustrating Mr. W. H. A. Jacobson's paper on Middle Meningeal Hæmorrhage.

PLATE IV.

FIGS. 1 and 2 are introduced to show how much the distribution of the branches of the middle meningeal artery varies in different parietal bones (p. 149).

FIG. 3 shows a point of much practical importance, and one to which attention does not appear to have been previously drawn, viz. that in skulls of quite average thickness there is often striking thinness and translucency along the track of the chief branches of the middle meningeal artery.

PLATE IVA.

The two figures in this plate are introduced to show middle meningeal hæmorrhage and a condition of things which is liable to be confused with it; one, in fact, which, often coexisting with middle meningeal hæmorrhage, proves a fatal complication, viz. contusion, laceration, and ecchymosis of the brain.

Both these figures are taken, by permission, from Mr. Hutchinson's 'Clinical Surgery.' The one on the right, fig. 1 ('Clin. Surg.,' pl. liv), is an excellent instance of the position and shape of a middle meningeal clot, and the way in which it compresses an otherwise uninjured brain. The one on the left, fig. 2 ('Clin. Surg.,' pl. l, fig. 1), shows another result of fracture of the side and base of the skull, viz. contusion and ecchymosis of the brain. How difficult or even impossible it may be to diagnose between this condition and middle meningeal hæmorrhage is shown at p. 279.

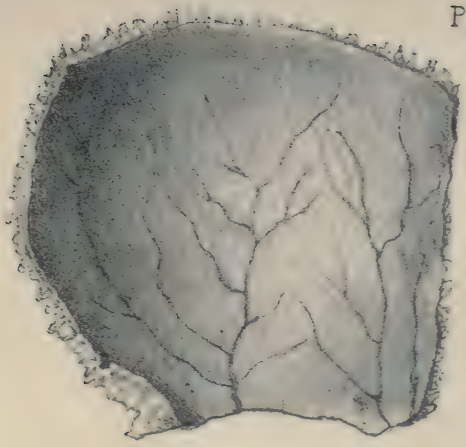


Fig.1

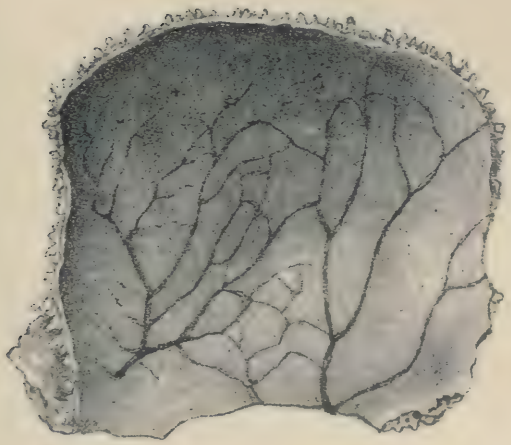
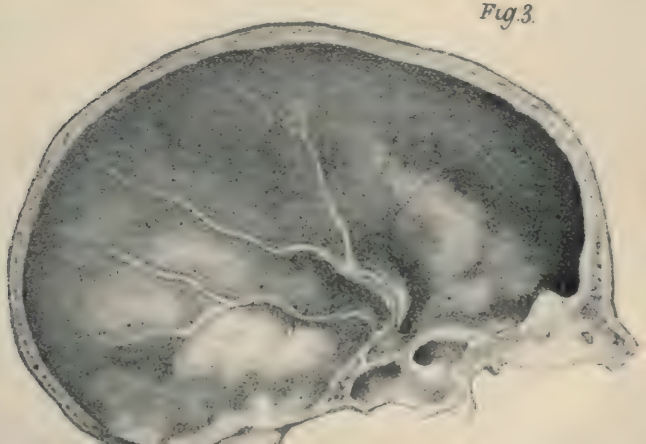


Fig.2

Fig.3.



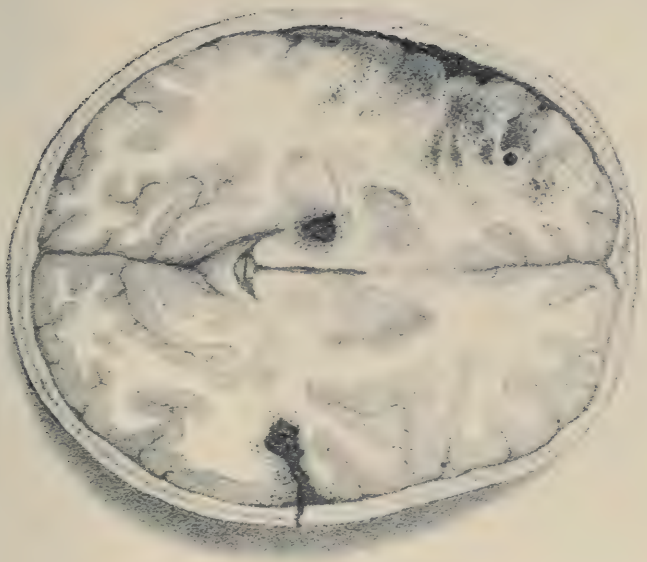
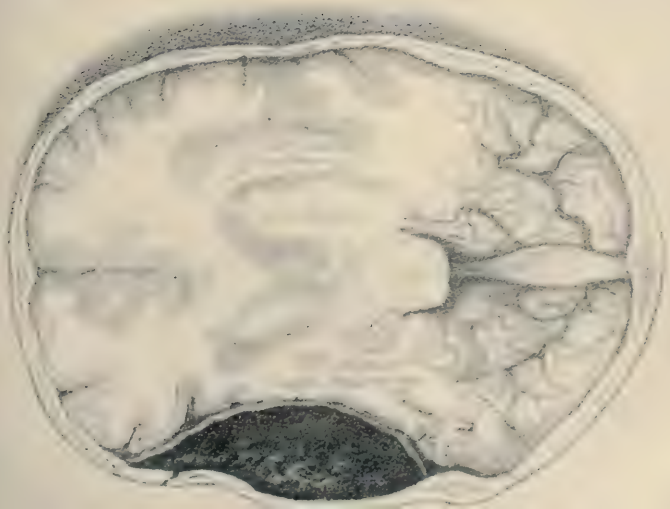


Fig 2.



his coma merely to die of hæmorrhage. In each case the source of this blood could be neither seen nor felt, so that none of the ingenious theoretical plans of arresting it which are recommended in text-books could be employed. In both cases it was very soon arrested by putting the patient in the sitting posture (of course watching carefully for signs of syncope), and applying a large ice-bag over the whole side of the face, head, and neck. Each case showed, however, that it is perfectly impossible to prevent the accumulation of clot to a certain extent, but as there is a large hole in the skull to serve as a sort of safety-valve, the pressure is so diminished as not to be incompatible with life. In order to ensure this it is necessary to make use of a large trephine; a small trephine hole would be almost useless. The small lithotomy scoop proved a most valuable instrument for removing the clot. It may be questioned, however, whether, as the clots always reform to some extent, it is worth while removing them at all, and whether it would not be enough to trust to the safety-valve action of the trephine hole. Probably it is better to remove the original clot, which from its slow formation and the pressure it has been exposed to is somewhat dense, and the expanding power of the brain seems hardly sufficient alone to expel it. On the other hand, the newly-formed clot after the operation is much more readily expelled. In the child death seemed to occur from hyperpyrexia. The coma had completely disappeared. It could swallow well and seemed likely to recover, when the temperature suddenly ran up to 108°, the pulse became uncontrollable and the respiration excessively rapid. Death quickly followed. In the same way in the woman there was a marked rise in temperature after the first few hours, and at the same time the pulse rose to 120, and the breathing became more embarrassed. The rise of temperature occurred much too early to be septic or inflammatory in its origin; moreover, there were no signs of inflammation or of congestion of the membranes in either case. It must therefore be of purely nervous origin, and its exact nature is difficult to explain. In the child the most careful search failed to show any large vessels wounded, and the hæmorrhage must have come from a multitude of small vessels. The hæmorrhage must, in the first place, have occurred along

the line of fracture, and the dura mater have been thus stripped from the bone. As it was stripped off other small vessels were torn, which in their turn helped to furnish blood. This process is readily conceivable in the vascular dura mater connected with the growing bones of a child's skull.

Although these cases terminated fatally they are no discouragement to a repetition of the operation; in each case the patient was relieved from a condition absolutely incompatible with life, and given a chance of life, small though that chance seems to be. It is to be hoped also that statisticians, when estimating the mortality of the operation of trephining, will remember that in such cases as the above the operation has nothing whatever to do with the death of the patient.

Case 29. *Fractures of left side of vault extending into base of skull (middle fossa), this region being splintered; rupture of anterior division of middle meningeal artery; slight bruising of temporo-sphenoidal lobes; contracted mitral; death within fourteen hours.*—W. E. R—, æt. 23, was admitted under the writer's care in the absence of Mr. Howse, August 8th, 1881, at 5.30 p.m., having fallen from the top of an omnibus on to his head. It was thought that he had been seized with a fit, as he had fallen in one, eight weeks ago, while talking to some friends. There was a bruise above and just outside the right orbit. The patient was pale and clammy, just sensible enough to resist handling. A presystolic bruit and a large heart were diagnosed. He became more and more insensible up to 10 p.m., and was noticed to have some loss of power on the right side. The writer was called to him betwen 10 and 11 p.m., and found him lying on his back, breathing stertorously; the left pupil was dilated, the right contracted, both were insensible to light; resp. 56; pulse 116. By pricking with a pin some movement could be detected in the upper and lower extremities of the left side, none in those of the right. The patient died at 9 a.m. the next morning, having remained unconscious all night, with stertorous breathing.

Post-mortem examination.—A fracture extended from an inch and a half to the left of median line of vertex downwards about a quarter of an inch in front of posterior border of frontal bone into base, ending just behind the inner end of the left

sphenoidal fissure. The fracture crossed the anterior division of the middle meningeal artery. Lying between the bone and the dura mater were 4½ oz. of solid blood-clot pressing inwards the left temporo-sphenoidal lobe, posterior part of left frontal, and anterior part of left occipital lobes. The effused clot more than filled up the middle fossa. The fracture, as it entered the base of the skull, gaped widely, and contained a large loose splinter of bone. The anterior part of the left temporo-sphenoidal lobe was rather bruised, a small extravasation into the cortical substance being also present. The right anterior temporo-sphenoidal lobe was also slightly bruised, but no blood was effused into its substance. Beyond the above bruising and the effect of the pressure of the clot, the brain presented no abnormality. The fracture on approaching the vertex ran into the coronal suture, and the suture an inch nearer the middle line was crossed by a fissure horizontal and running parallel with the sagittal suture for an inch and a half on either side of the left coronal suture.

Both lungs were intensely affected in their bases with hypostatic pneumonia.

The heart weighed 17½ oz., the left side was much hypertrophied, the interventricular septum enormously so, and bulging into the right ventricle to an extreme degree. Mitral orifice contracted. Right side also hypertrophied to a much less degree. Kidneys: These were firmer and tougher than natural with fine general puckering of the cortex.

Remarks.—The writer of this article is entirely responsible for trephining not being performed in the above case. Too much weight was attached to the belief that the base was fractured owing to the severity of the fall (from the top of an omnibus). While it was proved by the post-mortem examination that this opinion was correct, and that the base was implicated not by a mere fissure, thus "the fracture as it entered the base of the skull gaped widely and contained a large loose splinter of bone," the writer still regrets that the chance of relief from the compression was not given by trephining. The diagnostic value of one widely-dilated pupil, *i.e.* on the side of the meningeal hæmorrhage, was not known to him at that time. It will be shown later on, p. 272, that while this condition has been recognised by other writers, we

owe to Mr. Hutchinson its explanation, *i. e.* that the presence of this condition of the pupil means that the clot extends down into the base of the skull, and is thus able to make pressure upon the third nerve.

Case 30. *Fissure-fracture of left side of skull extending into middle fossa; laceration of posterior division of middle meningeal; trephining; death on the seventh day of broncho-pneumonia in a patient of* 61.—J. C—, æt. 61, was admitted Monday, August 17th, 1885, under the writer's care in the absence of Mr. Durham and Mr. Golding-Bird. He was said to have fallen down while drunk on Saturday, the 15th, at 11 p.m. into an area, a height of ten feet, striking the left side of his head against the ground. On the 16th there was bleeding from the left ear and the patient was sick; he was said on this day to have had the action of his bowels and passed his water, but it was extremely difficult to get any accurate or complete history.

Condition on admission—Patient quite unconscious. Breathing puffing rather than stertorous. Pupils equal, both rather contracted, but responding to light. Paralysis of right side of face, mouth drawn to left side. Right eyelids not closed. A little dry blood in left external auditory meatus. Right limbs quite paralysed both as to motion and sensation, does not feel pricks of needle over right arm and leg. Moves left extremities freely and strongly. Left temporal region feels rather soft and full as opposed to right side.[1] No scalp wound, no evidence of fracture. A little chloroform having been given, a crucial incision was made an inch and a half behind and an inch above the level of the external frontal angle. The pericranium being stripped up carefully, the trephine was applied. The bone was extremely thin, and about six half-turns of the trephine served to bring away a crown of bone traversed on its inner surface by a deep meningeal groove. A little black clot, in reality the anterior and lower extremity of a very large one, was seen upon the dura mater. This membrane pulsated vigorously and was convex at the site of trephining. But on enlarging the opening upwards and outwards the clot was found to be of large size, extending right up to the vertex, down to the ear, and upwards and outwards

[1] This was found, a quarter of an hour later, to be a mistake.

under the parietal eminence. It was now seen that a fissure-fracture ran down the left side of the vault through the parietal and squamous portion of the temporal towards the base, thus probably accounting for the hæmorrhage from the ear. As it was evident that nothing like the whole of the clot had been exposed, the horizontal part of the crucial incision was prolonged outwards and upwards and a second crown of bone trephined out by Mr. Targett, the senior house surgeon, this piece of removed bone being two and a quarter inches from the first and three quarters of an inch higher up.

The intervening and surrounding bone having been chipped away freely with Hoffmann's forceps, the dura mater was exposed for a space of three inches horizontally by nearly two inches vertically, covered with black, soft, friable clot. Four ounces of this were scooped away with the fingers. A depression in the left side of the brain into which three fingers could easily be laid remained; no pulsation whatever over this area. A little bright-red blood welled up at the lower border of the clot, pointing probably to the site of laceration in the artery; this oozing was easily controlled by pressure. Strict antiseptic precautions were taken throughout the operation.

Aug. 18th, 5 p.m.—Has been conscious and quiet till now, when he has become very restless and abusive. No movement of right side. Quite deaf on left side, but can hear on right; is conscious enough to follow the voice when spoken to loudly, and asks for drink. Dressings changed owing to his restlessness. Flap in good position, very little oozing, no fresh clot. To take two pints of milk and three ounces of brandy during the night and up to noon, with a quarter of a grain of morphia subcutaneously occasionally. Stertor quite stopped.

19th (2nd day).—Much more conscious, and less abusive and foul mouthed. Voice clearer; says distinctly, "I'm all right, thank God," "I've no pain," "I want a drink," &c., but nothing more sustained. Quiet and drowsy towards evening. Coarse râles over both lungs behind. A little distinct tracheal râle as well. To be kept propped up and put in flannel.

20th (3rd day).—Bronchitis increasing. Expectoration greenish and nummular looking, but scanty in amount. Breathing increasingly difficult throughout the day, but with-

out stertor. A good deal of oozing to-day from back of dressings, quite sweet. Anterior two-thirds of wound in good position, the posterior part still gapes, and shows here that the cavity in the brain is filling up, pulsation being very marked to-day at this spot.

22nd (5th day).—During the last three days the patient's condition has fluctuated, but on the whole the bronchitis has gained ground, and the strength has slowly failed. He is generally quiet in the day, restless towards evening, necessitating daily dressing of the wound. This has closed very much, There has been no suppuration. Discharge sweet throughout. The highest recorded temperature has been 100·7°. Pulse usually 120, soft and inclined to intermit. Respiration usually 28 to 40. Has taken his food well. This has been gradually increased to milk ad. lib. Brandy ʒiv and sherry ʒij. Yolks of four eggs. Ale O¼. Cal. gr. v have been given twice, and $\frac{1}{6}$ or $\frac{1}{8}$ gr. of morphia occasionally for the restlessness.

Aug. 23rd (6th day).—The breathing now went up to 50. The pulse became more intermittent. Tracheal râles were again heard, and this continued till the patient's death about noon on Aug. 24th, or seventh day after the trephining.

Post-mortem examination.—A linear fracture ran through the left squamous bone, opening the posterior division of the left middle meningeal artery, into the middle fossa across the anterior border of the petrous bone, and ending at the upper orifice of the carotid canal. The depression of the brain noticed at the time of the operation, p. 209, as allowing three fingers to be laid in it, was almost effaced, some slight flattening only remaining over the upper and posterior part of the parietal lobe. A little blood still remained on the dura mater over this region. No bruising of temporo-sphenoidal or frontal lobes. No evidence of meningitis. The lungs were remarkably emphysematous and showed abundant evidence of broncho-pneumonia at both bases, especially on the right side. Here the tissues were very soft and friable, in parts almost rotten to the touch, with patches interspersed of dark purple plum colour and of apoplectic character.

Remarks.—This was a vexatiously disappointing case. An old man of 61, who has fractured his skull and sustained a rupture of a middle meningeal artery, is not brought to the

hospital for nearly forty-eight hours, trephining is performed at once, some consciousness is soon regained, and improvement in this and in general condition is increasing till the fifth day, when evidence of broncho-pneumonia becomes more marked, the patient succumbing to this on the seventh day after his injury, no meningitis having supervened and the brain having shown great power of recovery. The fact that very little, if any. power was regained over the right or paralysed side may perhaps be accounted for by some more deep-seated lesion in the brain. This, save for some slight remaining evidence of compression, was quite uninjured on the surface, no bruising whatever being found as was expected (after such marked depression by the clot) on the under surface of the opposite temporo-sphenoidal lobe. The brain having been preserved for hardening in order to show its extent of recovery, no sections have yet been made. The amount of food and stimulants which the old man took, and took with benefit, though with fractured base and recently relieved compression, is perhaps interesting when compared with what is usually taught as the treatment of such injuries. The question as to whether it is advisable to remove the bone so freely in order that the clot may be completely removed has been already raised at p. 173; it will be again referred to under the heading Treatment, at p. 303. But whether this free removal of bone was needful and judicious, or no, such free removal, of which a fair idea is given at p. 209, and handling of the dura mater followed by absolutely no meningitis, but simply by kindly though weak repair, the highest temperature being 100·7°, speak with powerful eloquence in favour of Professor Lister's treatment.[1]

The next case is of great interest, not only from the long duration of life—upwards of nine days after the accident, which led to rupture of the artery—but also from the slight degree and very temporary duration of the compression symptoms.

Case 31.[2] *Fracture of right parietal bone involving base of skull, rupture of middle meningeal artery; death on the ninth*

[1] The writer may here express his thanks to Mr. Roberts, Mr. Durham's dresser, for all his trouble with this case.

[2] This and the next four cases are taken from four lectures by Mr. Hutchinson on "Compression of the Brain," 'Lond. Hosp. Rep.,' vol. iv, p. 11, *et seq.*

day from erysipelas and pyæmia.—A man was admitted, about 10 a.m., having fallen head first into a ship's hold, with a severe laceration of the scalp over the right parietal bone. This was laid bare over a considerable extent, but no fracture could be discovered. In the receiving-room he was quite conscious, answered questions, put out his tongue, &c., and no degree of paralysis was observed. At the time of Mr. Hutchinson's visit in the afternoon, six hours after the patient's admission, his condition had become worse; pulse 84, soft and deliberate, pupils rather small and of equal size. Patient uses his left limbs much less quickly and less vigorously than his right ones. Sensation, however, appears to be good in the left limbs, for when they are pricked he at once moves the others in the attempt to defend himself. He can speak clearly and complains much when irritated; but he will not answer questions nor put out his tongue. He is anxious to be let alone, and to be allowed to sleep.

Mr. Hutchinson pointed out that the man's condition was, for the most part, that of a case of severe concussion, in the stage of but partial recovery from collapse. Thus he was chilly, stupid, and sleepy and very irritable when roused; but he had one symptom which did not fit with mere concussion, *i. e.* the very decided though partial paralysis of the left arm and leg. Several of the chief symptoms of compression, however, were absent. The man was not insensible, his pulse was not laboured, his pupils were not dilated, nor was his breathing stertorous, yet he was getting worse, and the limbs opposite to the injured part were partially paralysed. Mr. Hutchinson suggested as possible that he had sustained a contusion of the right middle lobe of the brain, which, in addition to the general concussion of the whole, might fairly account for his symptoms. It was agreed, however, that he should be carefully watched for the next few hours, and that if the paralysis increased and he became insensible, the trephine should be used over the right meningeal artery. On the following day he was much better, the hemiplegia had quite passed off and he had regained full consciousness. He could hold both arms straight up for some little time, appearing to do this as well with the left as with the right. No difference could be appreciated in the movement of his legs.

He had been restless during the night and had twice got out of bed, but was unable to stand without assistance; pulse 80; respiration tranquil, without the slightest stertor. He was absolutely deaf. As this affected both ears, and was not attended by facial paralysis, it was probably not due to fracture of the petrous bone. Mr. Hutchinson pointed out that the auditory nerve could scarcely have been lacerated, since it would have been extraordinary that such a lesion should have affected both nerves, and yet not on either side have implicated the portio dura as well. He supposed therefore that some central hæmorrhage had occurred, implicating the auditory ganglia.

On the third day erysipelas of the scalp appeared, and spread to the face; on the sixth day symptoms of pyæmia appeared, and the patient died of this on the ninth day. The only new symptom pointing to the existence of middle meningeal hæmorrhage was dilatation and immobility of the right pupil. That this was fully twice the size of the other was noticed on the eighth day.[1]

Post-mortem examination.—There was a fracture of the base of the skull, the lines of which, commencing on each side in the foramen magnum, passed forwards across the petrous bones and met in the body of the sphenoid. On both sides the cavity of the tympanum was full of blood-clots, the membrana tympani being, however, on each side unbroken. Thus the absence of bleeding from the ear, and the utter deafness were explained. On the right side of the skull a fissure passed upwards from the base across parts of the greater wing of the sphenoid and squamous part of temporal bone into the parietal. By this fracture the middle meningeal artery had been torn, and a large effusion of blood between the bone and dura mater had followed. The solid blood-clot was an inch thick, and consisted probably of two or three ounces.

Mr. Hutchinson considered that the hemiplegia which was present on the first day and gone on the second, and which never reappeared, was due to the blood-clot. This had probably been rapidly effused, and for a time caused compression of the adjacent hemisphere. In a little time the brain had yielded

[1] It is possible that the inflammation of the erysipelas had, by increasing the vascularity of parts in its neighbourhood, led to a fresh hæmorrhage.

and accommodated itself to the intruded blood, and the signs of compression ceased. With regard to the cause of death Mr. Hutchinson goes on to say, "I do not think that either the blood or the fracture of the base had much to do directly with the man's death. He died of erysipelas and pyæmia, and as regards either of the special lesions mentioned, it is quite possible that he might have recovered, and excepting the risk of fresh hæmorrhage with sudden increase of compression, I do not think it would have caused danger in any way."

Case 32. *Fracture of anterior fossa of skull, passing on left side through middle meningeal artery; injury to brain trivial; death within thirty-six hours.*—A boy was admitted on a Thursday who had been knocked down and perhaps run over. There was a fracture of the upper half of the left humerus with great displacement. The chief bruise was on his temple, indicating perhaps that he had been struck there. Both upper eyelids were purple from extravasated blood, and there was a little bleeding from the nose. The patient was in collapse when admitted, but conscious and without paralysis; he complained of pain and resisted attempts at examination. He passed the rest of the day and the following night in great restlessness; he tossed about in bed and undid the bandages which had been put upon his arms. On Friday he was still very pale and with a cool surface. He would take his food, but was unwilling to be disturbed. We found about 3 in the afternoon that he could scarcely see with the right eye, and that his right pupil, which on the previous day had been of the same size as the other, was widely dilated and fixed. About 8 the nurse gave him some bread and milk, and he took it well. At 8.30 the house surgeon found him insensible and apparently dying. His breathing was now difficult and irregular, but there was no stertor, the pulse was upwards of 170. Death took place a few minutes later.

Post-mortem examination.—There was a fracture across the anterior fossa, taking the line of the junction of the lesser wings of the sphenoid to the orbital plates of the frontal bone. The fracture on the left side crossed the trunk of the middle meningeal artery, and a large clot of blood was found between the dura mater and the bone extending downwards into the

sphenoidal fossa, and there can be little doubt that by this the third nerve was compressed and that thus the dilatation of the pupil was explained.

Remarks by Mr. Hutchinson.—"Regarding the case now with the light which the autopsy has thrown on it, we can have little hesitation in assuming that the cause of death was compression of the brain. The quantity of blood found is quite sufficient to account for death. It would seem probable that a second hæmorrhage had occurred immediately preceding the boy's death; and the state of the clot, one half much softer than the other, seems to favour this view. I drew the attention of those who were present at the autopsy to the fact that the brain-substance was exceedingly pale, remarking that in all probability the manner in which compression proves fatal is by squeezing the blood out of the brain-substance. This case adds another to a considerable series which we have recently had showing that the orthodox symptoms of compression, absolute insensibility, stertor, slow laboured pulse and hot surfaces, are not by any means always met with. In the early stage of this case we had before us probably symptoms which were a mixed result of a slight degree of compression together with a very considerable degree of concussion. The blow by which the base of the skull was fractured must, of course, have severly concussed the brain; indeed we have evidence of this in the existence of a few small patches of ecchymosis into the brain-substance, beneath the anterior lobes. These were in themselves trivial, but become important as proof of the severe shake which had been received. I think you will agree with me in holding that we were not to blame for not having diagnosed the presence of blood in the situation where we found it. The symptoms were so altogether different from those supposed to be usual in compression, and so closely similar to those of severe concussion, that it was impossible to establish a differential diagnosis."

Case 33. *Fracture of left side of skull; extravasation from middle meningeal artery on this side; death in a very few hours, and very sudden at the last.*—J. S—, æt. 12, was admitted about noon, having fallen some distance through a trap-door. As the boy was by himself at the time of the accident no

accurate account could be obtained. When brought in he was quite sensible, able to stand, and seemed to be only somewhat shaken by the fall. In fact he ailed so little that the question was raised as to whether it was worth while taking him in, the only appreciable symptom being a swelling in the left temporal region. About 6 p.m. he vomited, and was purged several times, being sufficiently conscious to ask for the bed-pan. About 8 p.m. he began to scream out for his mother, and the nurse found him in a kind of fit. "Both hands were convulsed, but his face did not work and was of good colour." The house surgeon saw him in the course of a few minutes, and reports that his pulse was exceedingly rapid and that he was quite insensible. His left pupil was dilated. The diagnosis of compression of extravasation of blood from rupture of the left middle meningeal artery was made, and the propriety of trephining on that side discussed, but unfortunately the boy died within half an hour of the first urgent symptoms, that is about half-past eight, without any operation having been performed.

Post-mortem examination.—There was a considerable effusion of blood beneath the scalp on the left side, and a line of fracture was found passing partly in the coronal suture, partly in front of it, into the frontal bone. A large blood-clot was found between the dura mater and the bone on the left side, extending from a point an inch behind the mastoid process, to within an inch of the middle line in front. The clot was about half an inch in thickness at all parts. It was quite soft and like jelly.

Case 34. *Fracture of left side of skull extending into base (middle fossa); extravasation from a main branch of middle meningeal artery; contusion of brain trifling; death from simple compression in about four hours.*—"I saw this man about ten o'clock, and remained with him for about half an hour, until he died. We carefully noted the mode of death. He was quite insensible the whole of the time, and had been so almost from the time of his admission. He showed no reflex irritability, allowed us to open his eyes, &c., without the slightest resistance. His pupils were almost of equal size and not greatly dilated; the left was rather the larger, and

both of them were absolutely motionless; they did not appear to act in the least even on rubbing the eye.

The man's face was rather pale and his lips dusky. His breathing was slow and irregular, and attended occasionally with a certain degree of snorting. Every now and then he drew a very deep inspiration; his pulse was very peculiar; it was jerking and rapid, and yet very firm. I think I scarcely ever felt an artery more resistant to pressure than it was, yet it had a frequency of 148 in the minute. It was very irregular. During the whole of the half hour I was with him he was clearly dying, and several times his respiration entirely ceased for two or three minutes; on the occasion on which it ceased for the longest period his pulse gradually became more and more feeble during the three minutes that respiration was absent, and at length the pulse also all but ceased; he then began to breathe again, and the pulse rapidly rallied and became almost as strong as before. This went on for about ten minutes, when his respiration again ceased and never after returned. His pulse could be felt for fully five minutes after his last respiration, and it ceased very gradually.

The case proved at the post-mortem to have been one of simple compression. We found a linear fracture of the left squamous bone, extending downwards into the middle fossa of the skull, and upwards into the parietal bone. This fracture crossed one of the main branches of the middle meningeal artery, and there was an extravasation of blood between the dura mater and bone amounting, on measurement, to exactly two ounces. The blood occupied the side of the skull and did not pass into the sphenoidal fossa. It covered a large area at least as large as the whole palm of an adult hand, and was nearly three quarters of an inch thick at its thickest part. It had pushed the hemisphere towards the opposite side, and its adjacent convolutions were flattened by pressure. There was no blood in the arachnoid cavity. Both sphenoidal lobes at their lowest parts showed trifling evidences of contusion, there being some small patches of extravasated blood. It appeared that a line of fracture passed backwards from the principal one across the petrous portion of the temporal bone; but no motion could be produced at this part as it was a mere crack.

There were no other traces of injury to any part of the brain and cerebellum.

This case seems to be one of the most simple and definite examples of death from compression which we could possibly have. The only complication, probably, was a moderate degree of concussion. Death occurred very quickly, the man having lived only about four hours after his accident.

The intrusion into the cavity of the cranium amounted only to about two ounces; but in relation to this we must note that the head was decidedly small. The brain and cerebellum weighed only forty-two ounces. As to the effect of the compression on the brain itself, the veins of the pia mater were moderately full, but the brain-substance was pale.

The effect on the circulation had been very peculiar and definite, but it had not produced the slow laboured pulse usually supposed to characterise compression. The disturbance was perhaps too rapid to allow of the circulation becoming steady. As regards the early symptoms, they were those simply of severe concussion and passed so rapidly into those of compression that the interval was not well marked. Still, however, we had the fact that the man when admitted resisted efforts at examination strongly, and although he never spoke often seemed on the point of doing so. It was stated that when first taken up after his fall he managed to stand, but he never spoke. After his admission into the hospital he was tranquil, and then rapidly became totally insensible. At first his pulse was slow and feeble. In the early part of his total insensibility his breathing was decidedly stertorous, but it became less so afterwards. The hæmorrhage from his ear, and the severity of the symptoms from the first, led to the confident diagnosis of fracture of the base of the skull with probably severe laceration of the brain, but looking back on the history of the case, now that we know the results of the post-mortem, it is easy to see that although he had never been conscious the rapid increase in symptoms would quite have warranted an exploratory operation.

Case 35. *Fracture of right side of skull extending into middle fossa; extravasation from middle meningeal artery (anterior division); death within twelve hours, and very sudden at the*

last; no bruising of brain.—T. C—, æt. 22, was admitted under Mr. Durham, October 29th, 1873, having been thrown out of a train on to his head. He was seen in the surgery at 5 a.m., when he complained of pain in the head. Pulse and respiration at this time were normal. The patient was pale and seemed faint. The pupils were normal, and no evidence of fracture could be obtained. The man was told to lie on the couch for a while; ten minutes later it was noticed that his pulse was small and feeble, and that the man was becoming drowsy. He complained now of much pain in the head, but was able to walk into the ward to his bed, and did not require much assistance in undressing. At 7 a.m. his limbs were rigid and convulsed. The right pupil was dilated widely, the left one much contracted. On the left side the pupil was slightly sensitive to light, the right not at all. Respiration 30, quick and stertorous. Pulse 130, full and compressible. During the day there was considerable bleeding from both ears. The patient remained insensible, with loud and stertorous breathing. At 4 p.m. the face suddenly became livid, and the respiration stopped, though the heart continued to beat for some time.

Post-mortem examination.—There was a fracture on the right side of the skull running upwards from the middle fossa, and crossing the anterior division of the middle meningeal artery. Outside the dura mater, between it and the bone, was a thick black clot. This had a defined margin, was thinned off at the edges, and was an inch thick at its thickest part. The dura mater was carefully examined, but no wound in the middle meningeal artery could be seen, and a fine wire passed easily along it beyond the spot where the fracture crossed it. The right side of the brain presented a most remarkable flattening, six inches long by three and a half vertically. The brain here was literally as flat as a board, this condition extending from the middle of the posterior to the anterior lobe.

Remarks.—When first admitted, this patient, pale, faint, and with pupils equal, seems to have been suffering from concussion alone. That this had mainly passed off is shown by his ability to walk into the ward. His death seems to have been due to compression only. In such cases the widely dilated pupil on the side of the extravasation, the insensibility, stertorous breathing, and full pulse, will usually point to a large

extravasation from a main division or from large branches of the artery, rather than from several small vessels, in which case the hæmorrhage is neither so rapid nor so profuse. The sudden failure of respiration and consequently rapid death is worthy of note. That life may close in this manner in cases where the extravasation is a large one—thus, the flattening of the right side of the brain was six inches long by three and a half inches vertically—is very important, not only because the friends of a patient may have to be warned, but because a brain thus compressed and respiration thus embarrassed may be unable to sustain the administration of an anæsthetic.[1] The continuance of the heart's action after the failure of respiration is noticed at length by Mr. Hutchinson in the preceding case.

Case 36.[2] *Fissure-fracture of left parietal bone reaching into base (middle fossa); laceration of middle meningeal trunk; extensive extravasation and detachment of dura mater; injury to brain slight; trephining; death in about twelve hours after the injury.*—A brewer's drayman, while driving his cart on the evening of December 11th, fell off from the driving seat into the road, a crate also falling with him, and bruising the right side of his face and head. He got up on his box and drove some distance, then feeling giddy lay down in the van, and in about half an hour he was noticed by his mate to to be quite unconscious, and was driven at once to University College Hospital. On admission the patient was completely unconscious; the pupils were widely dilated and fixed; stertorous breathing, 18 per minute; complete general paralysis; pulse very full and tense, 32 per minute, slight bleeding from right nostril; over the back of the left parietal bone slight puffy swelling; left temporal fossa fuller than right, puffy. A stimulant enema was given and at once returned.

Mr. Beck came about 10 p.m. and found the patient's condition unaltered. He at once trephined over the left middle meningeal artery, an inch and a half above the zygoma, and an inch and a half behind the left external angular process. Here he found a fissure in the bone, and on removing the

[1] See remarks at pp. 186 and 296.

[2] Mr. Erichsen, 'Lancet,' loc. supr. cit.

crown the groove of the artery was found upon it divided by the fissure. Fluid blood and soft coagula at once welled up from the wound. There was a very large clot underneath the skull, which was removed by the lithotomy scoop. The dura mater was uninjured, depressed from the bone for two inches, and separated as far as the finger could reach in every direction. At first very free hæmorrhage occurred from the inside of the skull; the blood welling up, no artery could be seen or felt. Compression of the common carotid did not appear to have any effect on the hæmorrhage, which after a time got very much less. During the operation the patient's pulse rose to 60 per minute. A fold of lint wet with iced carbolic lotion was applied to the wound and the patient was carried back to bed, the blood then only trickling out of the wound. Pulse was much smaller, irregular, occasionally intermittent, 52; paralysis and other symptoms remained in the original condition.

January 12th.—At 8 a.m. the patient died.

Post-mortem examination.—A little blood under the scalp on the left side, and in the left temporal muscle. A fissure was found running from just above the left parietal prominence into the trephine wound, and from the further side of that, downwards and forwards, ending just below the outer end of the lesser wing of the sphenoid bone. At one place in the very thin squamous bone it was starred. The trephine had been used two inches behind the external angular process and an inch and a half above the zygoma. Longitudinal sinus healthy, surface of brain dry, convolutions very flattened. A slight bruise on the under surface of the anterior end of the right temporo-sphenoidal lobe just opposite the point struck. The left corpus striatum projected considerably further into the ventricle than the right. No hæmorrhage into or laceration of any part of brain or medulla; nothing to account for persistence of compression-symptoms apart from the clot under the skull. The dura mater was found to be detached from the skull on the left side for a space several inches in diameter, extending forward to the small wing of the sphenoid, downward to the petrous portion of the temporal bone, upward nearly to the middle line, and backward to the middle of the posterior fossa of the skull. It was separated some distance

from the skull, and the space filled up with soft black clot about the size of the hand. The middle meningeal artery was found to be torn, but not divided, at a point opposite to the starred fracture, just behind and beneath the small wing of the sphenoid. No other injury detected.

Remarks.—Mr. Erichsen points out that the swelling in the temporal region was due to blood oozing through the fissure, that there was no uprising of the brain, and that the man died rapidly in coma.

He further remarks, "Having removed the clot, what do you do with the middle meningeal artery? If it is torn, as in this case, you cannot stop the hæmorrhage, and there is no necessity to do so; you will find the hæmorrhage cease of itself. There is a very curious condition connected with this middle meningeal artery, and it is this: when it is wounded in such a place, and is exposed, it bleeds a little, but it does not bleed per saltum,—the blood merely wells out from it, and the hæmorrhage very soon ceases. Probably the artery contracts, but in this case it did not do so, because the artery was only partially divided; it could not contract or retract."[1]

With all due deference to the opinion of Mr. Erichsen, the above statement that there is no necessity to stop hæmorrhage from the middle meningeal artery, and that such hæmorrhage will stop of itself, is a misleading one. This is abundantly proved by the two cases of Mr. Howse, Nos. 9 and 64, in one of which a freezing mixture, in the other ligature of the external carotid had to be resorted to; by that of Mr. Symonds,[2] No. 65, in which after great difficulty the hæmorrhage was only arrested by the combined use of several methods; by those of Mr. Beck, Nos. 27 and 28, in which the bleeding was so free

[1] M. Tillaux ('Anatomie Topographique,' p. 45) points out that owing to its intimate relations with the dura mater, retraction and contraction of this artery cannot take place. "L'artère méningée moyenne, avons nous dit, est comprise dans l'épaisseur de la dure-mère; elle y adhère par toute sa circonférence. Il est donc aisé de concevoir qu'après la blessure de cette artère, les conditions de l'hémostase spontanée (retraction du vaisseau, diminution de son calibre) ne pouvant être remplies l'hémorrhagie s'arrête très difficilement."

[2] Remarks by Mr. Howse and Mr. Symonds on the subject of this most difficult hæmorrhage will be found in the Clinical Society's report ('Brit. Med. Journ.,' Oct. 17th, 1885) of a paper by Mr. Symonds on "Trephining for Middle Meningeal Hæmorrhage, and the best means of arresting it."

as to make it appear probable that the patient had only been relieved of his coma to die of hæmorrhage, and in which the loss of blood was arrested by raising the patient and applying large ice-bags. Further remarks are made on this subject under the head of treatment, pp. 298—302.

Case 37. *Fracture of left side of skull extending into posterior fossa; laceration of middle meningeal artery; no ecchymosis or laceration of brain; death on the second day.*—J. D—, æt. 49, admitted under Mr. Cock, April 6th, 1857. Patient, a commercial traveller, was thrown from his gig on to his head. He got up and walked for about half an hour, when he became confused and staggered. He went into a shop and was supposed to be intoxicated; at length, becoming perfectly insensible, he was taken to the hospital. It was clear from the history that a vessel had been lacerated, and no doubt the left meningeal artery, as over the region of this a scalp wound existed. It was thought, however, that some more profound injury was present, *e. g.* fractured base or laceration of brain. The right arm appeared more rigid than the left, and at the same time partially paralysed, as the patient did not move this limb, while he did the left. The coma continued and death took place on April 8th.

Post-mortem examination.—Scalp wound on left side of head. On removing the calvarium a large clot of blood was seen lying on the dura mater, and proceeding from the middle meningeal artery. This clot had separated the membrane for a considerable distance from the skull and thus several ounces of blood had been effused. This formed a globular tumour pressing on the brain; it was about two and a half inches in diameter and more than an inch thick. A corresponding depression was seen in the middle of the left hemisphere, but situated more behind the centre than in front. The pressure had caused some alteration in the shape of the remainder of the brain; thus the whole of the longitudinal fissure presented a concavity towards the injured side.

The skull was fractured by a perpendicular fissure beginning about the centre of the parietal bone, and passing down behind the temporal to the suture between the occipital and petrous bones, ended in the jugular foramen. The calvarium was very

thick and spongy, whilst the bones at the base were in some places as thin as paper.

Case 38. *Fracture of right side of skull passing into posterior fossa; laceration of posterior division of middle meningeal artery; ecchymosis of brain very slight.*—The patient was said to have been found drunk in an area; he was taken to a police station, where he remained all night. The next morning (May 25th, 1862) he was admitted under Mr. Cock. He was sensible, but apparently under the influence of alcohol. Involuntary defæcation had taken place. The left arm was weak and almost powerless. There was slight bleeding from the right ear, but no fracture could be detected in the skull.

Post-mortem examination.—On removing the scalp a fracture was found to have occurred on the right side and rather posteriorly. Thus, from a point at the posterior part of the parietal two lines of fracture were seen, one running downwards and the other downwards and forwards, quite across the occipital and petrous bones on right side, opening up the tympanum. A posterior branch of the middle meningeal had been torn, causing a large effusion of blood on the dura mater, between this and the bone. This effusion was a large mass, the size of the palm of the hand, and of the usual cup-like form. Amongst the clot was some fluid blood which was perhaps more recent. The brain, *i.e.* the right hemisphere at its middle and posterior part, was much depressed, its substance was only slightly ecchymosed in one or two spots, and these were changing to a yellow colour.

Case 39. *Extensive comminuted fracture of left and right sides of skull not involving base; hæmorrhage from middle meningeal artery on left side; slight bruising of brain; rapid death.*—J. C. B—, æt. 12, admitted under Mr. Hilton, June 27th, 1862, died very shortly after admission. He had fallen from a height of ten feet. He lay in a state of deep coma, the respiration being especially affected and suggesting some injury to the base of the brain.

Post-mortem examination.—On the left side of the skull was a comminuted fracture from which a fissure ran across the forehead to the temple on the opposite side, the calvarium

being thus loosened and it being possible to remove it altogether with very little difficulty. Immediately beneath the seat of injury on the left side was a large clot of black blood between the bone and the dura mater. This produced a depression in the left side of the brain. There was no laceration of the dura mater nor of the brain, nor was there any blood on the surface of the latter. The base of the middle hemisphere on the right side was slightly bruised, the rest of the brain and medulla being quite healthy.

Case 40. *Fracture of left side of skull involving base; rupture of middle meningeal artery; slight ecchymosis of brain; death two hours after admission.*—J. L—, æt. 19, admitted March 8th, 1859, under Sir William Gull. He was found lying insensible in the van of which he had charge; shortly before he had been speaking to his comrades, from which it was thought that he had had a fit. When admitted he was quite insensible, but there was no paralysis. Death took place in two hours.

Post-mortem examination.—No bruise on scalp, but on reflecting this much blood was found beneath it covering left side of head. On removing the calvaria a fracture was seen on the left side with a large quantity of blood effused between the dura mater and the bone, separating the former down to the base and forming a large tumour which pressed upon the side of the brain. There was a laceration of the middle meningeal artery, and the oozing had no doubt been gradual. The brain immediately adjacent was perfectly healthy, but on the opposite side, at the base of the middle lobe, was a slight ecchymosis of the brain. No injury elsewhere. The fracture commenced on the left side at the lower part of the parietal bone, and running transversely across it was another about two inches long. Both were merely fissures, there being no displacement. The first ran through the squamous bone into the middle fossa, in front of petrous bone as far as the foramen ovale.

Case 41. *Fracture of left temporal bone involving base; rupture of anterior division of middle meningeal artery; no injury to brain beyond compression; death seven days after the accident.*—J. M—, æt. 40, was admitted under Mr. Cock, June 19th,

1864, and died June 24th. He had been picked up insensible after a row in a public-house; he lay there for twenty-four hours and was then brought to the hospital. There was partial paralysis of the right side, and bleeding from left ear. No fracture could be detected. The patient never rallied.

Post-mortem examination.—On removing the calvaria a large clot of blood was seen lying between the dura mater and the bone in the region of the left temple. The anterior division of the middle meningeal had been torn through by a fracture in the temporal bone which ran across the vessel, and then into the petrous portion. The brain, through much indented, was not injured in the least degree, nor was there any blood extravasated into its substance. On the arachnoid was a small film of lymph which was easily separated.

Case 42. *Fracture of right side of head, extending into base (middle fossa); rupture of middle meningeal artery; slight bruising of brain; death within twenty-four hours.*—J. R—, æt. 29, was admitted under Mr. Cooper Forster, June 23rd, 1873. He had been fighting on the previous evening and fell on his head. He remained quite sensible till the middle of the night, when he became comatose. The coma continued till his death on June 23rd.

Post-mortem examination.—A blood tumour on left side of head, no scalp wound. Commencing near the anterior inferior angle of parietal bone on right side a fissured fracture extended thence through squamous part of temporal into the middle fossa, reaching nearly as far as the sphenoidal fissure. The middle meningeal artery was torn across opposite to the fracture, and its ends separated for about two lines. About four ounces of clot lay between the skull and the dura mater, extending downwards into the middle fossa. Blood was extravasated under the scalp, all round the back of the head, from left to right side. Bones not depressed. Brain slightly bruised at anterior part of middle lobe of right side, the bruising indicated by slight blood extravasation, not extending more deeply than a line into the brain-substance.

Case 43. *Fracture of right side of vertex involving base (middle fossa); rupture of branch of middle meningeal artery;*

slight surface laceration of brain.—G. H—, æt. 28, was admitted under Mr. Bryant, July 25th, 1873. There was an obscure history of a blow on the head a month ago. He was knocked down the night before admission, his head striking the pavement. The pupils were dilated. The breathing slow, not stertorous. The coma passed quietly into death.

Post-mortem examination.—On right side of head about an inch behind frontal eminence were two cicatrices. Outside these, lower down and on the lateral aspect of the head, was a recent graze, and beneath this a clot of extravasated blood. Between the bone and the dura mater was a clot of dark blood, there being a vertical fracture of the skull on the right side terminating below in the middle fossa. A large branch of the middle meningeal artery had a longitudinal rent in it. The brain was bruised on the right side at the anterior part of middle lobe, close to the fissure of Sylvius, the surface being slightly lacerated and blood extravasated into the grey matter for an eighth of an inch.

Case 44. *Fracture of left side of skull extending into base (middle fossa); laceration of branch of middle meningeal artery; very large extravasation, six ounces; no laceration or bruising of brain-surface; death within an hour and a half after admission.*—J. A—, æt. 44, admitted January 11th, 1877, and only lived an hour and a half.[1]

Post-mortem examination.—The skull was remarkably thin. A vertical fissure ran through the left temporal fossa, down into the middle fossa. There was a longitudinal rent in one of the posterior branches of the middle meningeal artery, the left side of the brain being here much compressed by six ounces of clot which lay outside the dura mater. The brain was neither lacerated nor bruised, but it was not incised, being kept to show its altered shape.

Case 45. *Extensive fracture of the skull reaching base; middle meningeal extravasation; slight ecchymosis of brain; death in twenty-eight hours.*—J. L—, æt. 53, a stout bargeman, was admitted at 5 a.m. Nov. 16th, into the Westminster Hospital

[1] There is no surgical report whatever of this case.

[2] Under the care of Mr. Holthouse, 'Brit. Med. Journ.,' 1860, p. 4.

under the care of Mr. Holthouse, having fallen down a flight of ten stairs while intoxicated, striking his head violently against the wall as he fell at 7 p.m. the previous evening. When seen an hour after the accident by a medical man he was comatose, breathing stertorously, and his pupils were contracted. His symptoms were thought to be due to intoxication, but there being no amendment he was sent to the hospital.

When seen by Mr. Holthouse at 10 a.m. there was a large ecchymosis involving the right upper eyelid and temple, but none beneath the conjunctiva. There was no wound of the scalp, no depression or evidence of fracture. The face was dusky. The pupils were somewhat contracted and immovable, the eyeballs motionless, and no winking took place on touching the cornea or the eyelashes. The breathing was stertorous, the pulse but little affected. He vomited once while being examined. There was general paralysis, but it was more complete on the left side of the body, as, on tickling the sole of the left foot, not the slightest movements were produced; while on tickling the right the ankle was flexed and the toes extended. These symptoms did not vary materially till death at 11 p.m. on the 17th.

Post-mortem examination.—A considerable quantity of blood occupied the whole of the right side of the head beneath the scalp, as far forwards as the upper eyelid. Five ounces and a half of firmly coagulated blood were found between the bone and dura mater, which was pressed in and formed a cavity over the right hemisphere of the brain. No blood had reached any part of the base of the skull. A wide fissure or fracture was found extending from the posterior and superior part of the right parietal bone (which was here somewhat indented on the inner side), commencing an inch external to the sagittal suture and passing downwards and forwards a little above the anterior inferior angle of the parietal bone, crossing the coronal suture at right angles, the frontal portion of the frontal bone, and then across the orbital plate of the same bone two thirds of an inch from the posterior margin of the lesser wing of the sphenoid, and terminating at the optic foramen. The blood had evidently come from the middle meningeal artery, which was torn across, part of the vessel remaining with the skull, and hanging from it, with a long coagulum projecting into

and from this vessel. On slicing off a portion of the right hemisphere a small recent extravasation of blood was met with in its substance, a little to the outer side of the lateral ventricle.

Case 46.[1] *Depressed fracture of parietal and frontal bones; middle meningeal hæmorrhage; trephining; death on the fifteenth day with hernia cerebri and probably pyæmia.*—A boy, about fourteen years of age, fell from a scaffold near two stories high, and pitched on his head; when brought from Islington to the hospital he appeared to be almost in a dying state. The anterior inferior angle of the parietal and part of the frontal bones were found depressed. A piece of the cranium being taken out with the trephine, I discovered beneath it a large quantity of coagulated blood; I therefore made the next perforation nearer the trunk of the principal artery of the dura mater, from which I concluded that this hæmorrhage had taken place. Having gently removed some of the coagulum, and introduced my finger into the aperture which had been made, I passed it as far as the second joint before I could touch the dura mater. Fluid arterial blood now gushed out in such quantities as to keep the bone covered on which I was next to trephine. I ran no risk, however, in performing the operation, for the dura mater was depressed so much that it could not be injured. But to guard against even the possibility of such an accident, I introduced my finger between the dura mater and skull, and then perforated the bone with the trephine. Having thus removed a third piece, which was directly over the principal artery, I took out about four ounces of coagulated blood; upon which the dura mater quickly rose to its original level, and the hæmorrhage from the wounded artery ceased. I now entirely removed the depressed portion of bone, and thus uncovered all the dura mater which had been detached, so that I could distinctly feel its connection with the cranium all round. This satisfied me that no more extravasated blood was left behind. The lad, who at the beginning lay quite insensible, with a feeble intermitting pulse, and laborious interrupted respiration, became restless, and expressed sensations of pain towards the latter

[1] Abernethy, 'Surg. Lects.,' loc. supr. cit.

part of the operation. Being now asked, how he found himself he replied, "Very well;" whether his head ached, he answered "No;" if he was sure he felt no pain, he said he was sure, and wished we would leave him alone. I now took twelve ounces of blood from his arm, and he was put to bed, where he passed the night quietly. The next morning his bowels were completely emptied by a purge, and saline medicines, with antimony, were given, so as to keep the skin in a gentle state of perspiration. During the day he was sleepy and lay quiet; answered questions very rationally and complained of pain and giddiness in his head. The third day he was disturbed and less rational. Eight ounces of blood were taken from him and a blister was applied to his neck. These means relieved him greatly and he became quite tranquil and collected. On the sixth day symptoms of irritation again took place, and were again relieved by similar treatment. The dura mater had granulated, and the whole wound looked healthy. Everything went on remarkably well till the fifteenth day, when the patient was seized with rigor and pain in his head, and the healthy aspect of the wound was also changed. The following day there was perceived, in the middle of the exposed dura mater, an aperture through which a protrusion of the brain arose, covered by the pia mater, which retained its natural appearance. In less than twenty-four hours this tumour increased to the size of an orange; its surface was dark coloured and irregular, and the pia mater no longer distinguishable. The following morning the boy died; and his friends had removed the body from the hospital before I heard of his decease.

Case 47.[1] *Depressed fracture of right side of skull, extending into base; middle meningeal extravasation; trephining; death twelve hours after the injury.*—A man was knocked down by the iron hooks of a crane which fell upon his head from a considerable height. He was stunned at first, but soon recovered his powers of mind and body so far as to walk home, undress himself, and go to bed. A surgeon was sent for, who on his arrival found the man senseless and in a deeply apoplectic state. The patient was immediately brought

[1] From Abernethy's 'Surgical Works,' vol. ii, p. 36.

to St. Bartholomew's Hospital, when the functions of life seemed nearly suspended, as he was almost without sensation, his breathing being slow, irregular, and stertorous, with an unequal, intermitting pulse and cold extremities. The scalp covering the right parietal bone was wounded, and on dividing it more extensively, a fracture with depression was discovered running obliquely across the anterior and inferior angle of the parietal bone, over the temporal bone, and extending to the basis of the cranium, before the mastoid process. Several perforations with the trephine were made along the course of the fracture, and the depressed portion taken away. A surprising quantity of coagulated blood was found upon the dura mater, the coagulum being not less than an inch and a half in thickness and six or seven inches in circumference. On the removal of this coagulum, the brain, which had been indented by its pressure, remained in the same state as before, nor did it ever regain its original level, so that the patient experienced but little benefit from the operation, and he died about twelve hours after receiving the blow.

Group C.—Cases least hopeful for trephining, and probably hopeless from the first. Violence usually great. Laceration of one or more branches, or of trunk of middle meningeal artery. Fracture of skull, side and base, and sometimes involving more than one fossa. Brain not only compressed but contused and lacerated also, and these severely.

In these cases, owing to the greater violence and shock, the concussion itself may be fatal, or if not may so merge its symptoms into those of compression, without any interval between the two states, that the time for trephining may easily escape the surgeon.

Again, the contusion and laceration of the brain which are the chief cause of the frequency of death in these cases, are themselves elements of difficulty in the diagnosis, during life, of the existence of hæmorrhage. (See pp. 279—285.)

Case 48. *Extensive fracture of skull, comminuted on left side; base involved; rupture of middle meningeal artery; much contusion of brain; death twelve hours after admission.*—J. K—, æt. 43, was admitted under Mr. Birkett July 27th,

1860, and only lived twelve hours. He was a large heavy man who had fallen from a height of twenty feet, the skull being most extensively fractured.

Post-mortem examination.—A large effusion of blood existed beneath the scalp so that this felt quite pulpy. On removing the scalp and exposing the calvaria this was seen to be divided longitudinally by a fracture extending from the ethmoid in front to the occipital behind, on the left of this the bone was much comminuted, several pieces of the parietal being loose and depressed; a fracture also extended downwards across the temporal and the sphenoid through the base to the temporal on the other side. The left middle meningeal artery was ruptured, and a large amount of blood effused between the dura mater and the skull. On removing the dura mater a large amount of blood was also found upon the brain itself, this having escaped from the ruptured pia mater, and being met with chiefly on the left side, there being but little on the right. The left hemisphere in front immediately below the seat of injury was much damaged, the grey matter contused and filled with blood, while at one spot the medullary matter was pulped for an inch. The brain was also much contused upon the right side, on the under surface, by contre-coup.

Case 49. *Severe fractures of skull, one extensive and passing into base (anterior and middle fossæ); laceration of middle meningeal artery; very slight ecchymosis of brain; death within eleven hours after the injury.*—A. M—, æt. 25, was admitted under Mr. Cock, October 18th, 1859, at 9 a.m., and died very shortly after. He was a sailor on board ship in the river. It was stated by his comrades that on the previous evening between 11 and 12 p.m. he was struck on the head, that he afterwards walked about, but subsequently fell into an insensible state, when he was brought in. There were scalp wounds on the head, but no fracture was very evident, owing to the effusion of blood beneath the scalp. The patient was perfectly insensible and died quickly. From the history it appeared a case of middle meningeal hæmorrhage, and that, if the patient had been seen earlier, trephining might have been of some service.

Post-mortem examination.—On the left side beneath the

scalp a large quantity of coagulated blood was found. On removing the scalp the skull was seen to be severely fractured. On the top of the head corresponding to the superior anterior angle of the parietal bone was a fracture as if caused by a round instrument, a piece of bone of an oval shape and split in the middle being here depressed slightly. The anterior part of this fracture corresponded to the coronal suture. This was slightly separated by the force of the blow and contained some coagulated blood. This separation passed along the left half of the coronal suture to above the middle of the left parietal bone, where it met another fracture passing forwards through this bone.

This second fracture, which was doubtless due to a distinct blow from that which caused the first, extended from the left half of the coronal suture right through the frontal prominence to the orbit, and then passing right across the anterior and middle fossæ split the lesser wing, and following the course of the greater wing ended in the carotid canal. A frontal suture existed which also was separated at its upper part, and contained some effused blood. A large quantity of blood, the size of a fist, was found pressing on the left side of the brain. This had evidently come from the middle meningeal artery, being poured out between the bone and the dura mater; this latter membrane being not otherwise torn. The clot caused a great depression on the side of the anterior and middle lobes of the left side. The brain was otherwise but slightly affected, there being one or two slight ecchymoses, *e.g.* immediately beneath the lower fracture, and at the base of the middle lobe on the right. The ventricles and other deeper parts were healthy.

Case 50. *Fractures of all three fossæ of skull on left side; lacerations of branch of middle meningeal artery (without fracture) on opposite side; severe bruising of brain.*—J. M—, æt. 21, admitted under Mr. Bryant, May 28th, died at 2.30 a.m., May 29th. He had fallen down and struck the side of his head or been knocked down.

Post-mortem examination.—A heavy, muscular, young adult. Bruising of left mastoid region. Extensive fracturing of skull on left side. Thus starting from the temporal bone behind

the ear a fracture ran into the middle and anterior fossæ through the wings of the sphenoid, and backwards across the petrous portion of the temporal bone to the posterior fossa. The temporo-sphenoidal lobe was much bruised on this side, but not nearly so much so as on the right side and corresponding spot. Here the convolutions were extensively pulped and the middle fossa lined by a considerable thickness of clot. On scraping this away carefully, a branch of the middle meningeal artery was found to be torn.[1] How this occurred it is difficult to say, as there was no fracture whatever on this side. The artery seemed to have been lacerated towards the brain chiefly and not towards the skull, most of the clot being inside the dura mater. Besides these injuries a large extravasation had occurred in the grey matter at the upper part of the floor of the fourth ventricle on the left side; there were also numerous isolated extravasations all through the pons.

Case 51. *Severe fracture of left side of skull and base, detaching apex of petrous bone; laceration of middle meningeal artery; compression symptoms delayed for nearly three hours, then rapidly fatal.*[2]—J. K—, æt. 25, was admitted into the Westminster Hospital, under the care of Mr. Holt, at half-past seven p.m., November 25th, 1862, with symptoms of concussion of brain. He had fallen from a scaffold about seven feet from the ground two hours and a half before admission, and when he was found by his fellow-workmen about five minutes afterwards he was standing up against a wall. They spoke to him, and he said, "Never mind, I shall be better in a minute or so," and complained of being cold and of a pain in his side. When he came into the hospital he had all the symptoms of concussion of the brain, and on careful examination by the house surgeon no injury could be discovered except a bruise on the left side of the forehead. He remained in this state for about a quarter of an hour, when suddenly the symptoms of compression came on, the pupils became widely dilated (before being very much contracted), stertor and paralysis of the right side supervened, and he died in ten minutes, three hours having elapsed from the time he fell.

[1] This and similar cases may perhaps be explained by Sir C. Bell's experiments, alluded to above, p. 157.

[2] 'Med. Times and Gazette,' 1863, i, 239.

Post-mortem examination.—On opening the skull a clot of blood weighing three ounces and a half was found external to the dura mater, on the left side and anterior part of the brain, which was much compressed but not lacerated at this point. The hæmorrhage had evidently proceeded from the middle meningeal artery, which was found to be torn by a fracture passing through the squamous portion of the temporal bone on the left side, and also through the great wing of the sphenoid. The fracture had also extended across the petrous bone, the apex of which was broken off.

Remarks.—The delayed onset of the symptoms of compression for nearly three hours is most interesting, especially of course from a clinical, but also from a medico-legal point of view, p. 261.

Again, the very sudden onset and the rapidly fatal issue show that these patients with meningeal extravasation are in a condition of the utmost danger. It would be interesting to know if any stimulant had been given to the patient just before the symptoms of compression supervened. See remarks on Case 9, p. 172.

Case 52.[1] *Lacerated scalp wound (shell injury) on right side of head without fracture; linear fracture on left side of skull opening trunk of middle meningeal artery; gradual onset of coma, patient being able to walk three miles; death; ecchymosis of brain on right side.*—On the 8th of April, 1862 (after the Battle of Shiloh), my attention was called to a young man who was lying on his back in a tent in a state of profound stupor. The respiration was slow, stertorous, and of a puffing nature. The pulse was small, feeble, 84; pupils dilated—the left almost to its utmost extent—and completely insensible to light; left side of the body completely paralysed, corresponding extremities cold, the foot and hand being livid. The flexor muscles of both arms were contracted; fingers flexed, and thumbs turned inwards upon the palms. Upon raising the hands and letting them go they fell powerless. This was more particularly the case with the left limb. The left leg was firmly extended, powerless, and not so sensible to external impressions

[1] This case is recorded by S. W. Gross, M.D., 'Amer. Journ. Med. Sci.,' N. S., vol. lxvi, p. 45.

as the right, which was in the same condition, but to a less degree. A lacerated wound, about an inch in length, was found just below the right parietal eminence, and upon introducing the finger and making pressure upon the skull convulsive movements of the trunk and extremities ensued. The sensation imparted to the touch was that of a depressed fracture, but the bone was sound and the deceptive feeling was due to the manner in which the aponeurosis and periosteum were torn, the latter of these structures being detached for a considerable distance beyond the wound. When the injury was inflicted the man wore a cap the lining of which was lacerated by the projectile, while its exterior was not damaged.

The previous history of the case, elicited from a companion who accompanied the patient to the rear, a distance of nearly three miles, was that he had been struck by a piece of shell on the previous day, or about twenty-four hours before I saw him. He was knocked senseless, but soon recovered, vomited, was obliged to rest frequently on his way to the rear, appeared drowsy, and was unwilling to proceed after each stoppage. He made no complaint and was rational, but was restless during the early part of the night, and moaned so much as to disturb his friend, who desired him to keep quiet, which he did, although he made no answer. On the following morning he appeared to be in a deep sleep from which he could not be aroused, on which account my services were requested.

Although the legitimate conclusion was that the compression was due to extravasated blood, the symptoms were too obscure to warrant trephining at the seat of the injury, and nothing was done beyond the application of cold water to the shorn scalp, and the relief of the distended bladder. Life was extinct in five hours, and section disclosed an enormous clot between the left parietal bone and the dura mater, extending down into the middle fossa of the skull, and completely filling it up, and pressing upon the trunk of the third nerve at the sphenoidal fissure. There was a linear fracture passing through the spheno-parietal suture, and dividing the canal containing the middle meningeal artery, which was lacerated. On the right side beneath the contused, but otherwise uninjured, bone, the vessels of the pia mater were enormously distended, the gyral spaces were filled with semifluid blood, and, on slicing the

brain, small spots of ecchymosis were present at numerous points, and a clot, the size of a hazel nut, was seated in its substance, at a spot corresponding with the external injury.

Case 53.[1] *Contused wound of scalp with depressed fracture of temporal bone extending into base; rupture of branch of middle meningeal artery; trephining; death; laceration and ecchymosis of brain.*—A Hindoo, æt. 30, was admitted 21st April, 1866, having received a blow on the left side of the head from a heavy bamboo, which caused a contused wound over the anterior margin of the parietal bone, about two inches in length, fracturing the bone and depressing a portion of the size of half a florin, the pericranium not being divided. He was insensible, with stertorous breathing, feeble pulse, dilated pupils, extremities cold and rigid, with occasional convulsive extension, more marked on the right than the left side; pulse 76; resp. 39; temp. 100°. As the depressed portion of bone could not be otherwise raised he was trephined. It was then elevated, and considerable hæmorrhage resulted; clots of blood were removed, the pulsation of the brain was very marked, and after the operation the stertor ceased; he groaned and had occasional convulsions of the right side. The fits became less frequent, but complete consciousness was not restored; pulse rose to 90; reflex movements of legs when the feet were irritated.

23rd.—Pulse 70; temp. 99°; resp. tranquil; left pupil dilated, right normal; more conscious, opens his mouth when told to put out his tongue; occasional tossing of the right hand. Both upper extremities become rigid when fits occur.

24th.—Pulse 130; temp. 102°; constant jactitation of the right limbs; stertorous breathing; profound coma; fits recurring; head drawn to the left side. Died at midnight.

Post-mortem examination.—There was a fracture extending through the temporal and across the body of the sphenoid. Between the bone and dura mater there was a layer of clotted blood, extending for five or six inches beyond the wound. The brain underneath was softened, its substance lacerated

[1] This and the next case are given by Sir J. Fayrer in his 'Clin. and Pathol. Observations in India,' pp, 464 and 471.

and ecchymosed over a surface of the size of a sixpence. The other organs were healthy.

Case 54. *Fracture of left side of skull; meningeal extravasation; laceration of brain.*—A Hindoo woman, æt. 40, admitted 23rd September, 1866, was picked up by the police in the street with a contused wound of the occiput, left side. She was unconscious, pupils natural, but appeared to feel when pinched; pulse 120, small; upper extremities flexed and somewhat rigid. 6 p.m.—Rather more conscious, opens her eyes when loudly spoken to, but is unable to speak.

24th.—Pulse 120, weak; temp. 101°; resp. 32; more comatose; no stertor; extremities still flexed and rigid; cannot be made to swallow, bowels relieved by enema. 6 p.m.—Pulse 120, weak; temp. 102°; mucous râles; rigidity continues, no convulsions. Died the following morning.

Post-mortem examination.—The scalp in the vicinity of the injury was much ecchymosed. These was a fracture of the skull extending from the posterior aspect of the left parietal bone through the occipital. A large clot of blood three inches long lay between the bone and the dura mater under the fracture. The brain on the right side anteriorly was lacerated, and the substance about the laceration softened and ecchymosed. There was a smaller patch of softening of the anterior lobe of the brain on the right side.

Case 55[1]. *Head injury, without fracture; middle meningeal extravasation; no interval of consciousness; bruising and ecchymosis of brain; death in forty-eight hours.*—A middle-aged man was admitted, under the care of Mr. Le Gros Clark, into St. Thomas's Hospital immediately after he had fallen from a height of not more than ten feet on to his head. He was quite insensible. On examination, there was a scalp wound on the right side of the head, towards the vertex; it was about an inch long, and the periosteum was removed at one point, but no fracture could be detected. The breathing was stertorous, with groaning. The pupils were quite inactive, the left being

[1] This and the next case are recorded by Mr. Le Gros Clark, 'The Diagnosis of Visceral Lesions,' pp. 109, 114.

much contracted, the right somewhat dilated. He died in forty-eight hours without rallying in any respect.

Post-mortem examination.—There was no fracture, but on removing the skull-cap there was found to be a large mass of dark-coloured coagulum, weighing upwards of four ounces, beneath the left parietal bone, outside the dura mater, to which it was rather firmly adherent, and causing a marked lenticular depression on the surface of the middle lobe of the left hemisphere (the contusion was on the right side). There was no hæmorrhage into the arachnoid cavity, but a small amount beneath the arachnoid, over the left hemisphere of the cerebellum; and at the base of the anterior extremity of the right hemisphere the grey substance of the brain was bruised and ecchymosed. The white substance of the left cerebral hemisphere, beneath the depression caused by the clot, was studded with small blood-points looking like minute extravasations. The extravasation was not limited to the membranes and surface of the brain, but extended through its substance, involving the cerebellum and even the under surface of the cerebrum.

Case 56. *Very severe fracture of skull; middle meningeal extravasation together with blood in and beneath arachnoid space; no interval of consciousness really present, but evidence of compression delayed for half an hour; laceration of brain; death twenty-six hours after the injury.*—A bargeman, aged 51, was admitted under Mr. Le Gros Clark at the close of 1867. A heavy beam of wood had fallen perpendicularly, thirty feet, on his head. He was insensible and in a state of collapse, but without the symptoms of compression, making an effort to sit up, though apparently unconscious when spoken to. In less than half an hour his pupils became inactive, stertor supervened, the surface of the eye became insensible, the pulse was 42, and the temperature sank to 95°. At the same time puffiness over the parietal bone, which had before been observed, became more apparent. Reactionary hæmorrhage had occurred. He survived twenty-six hours, the face being flushed, the pulse rising to 128, the respirations to 40, and the temperature to 104·8°, two hours before his death. Both vertex and base were found fractured. The upper fracture commenced

as a fissure just behind the coronal suture, and was crossed at its commencement by another fissure, constituting, in fact, a starred fracture. On the right side this fissure extended downwards across the anterior half of the right parietal bone, and the squamous plate of the temporal; then backwards and inwards across the petrous bone, and partially through the basilar process of the occipital. The fissure on the left side took a similar course, but terminated at the middle lacerated foramen. Blood was extravasated on each side between the dura mater and skull, opposite the squamous suture; there was also blood effused into the arachnoid and over the surface of the brain in considerable quantity. The under and outer part of each middle cerebral lobe was lacerated.

Case 57. *Fracture of right parietal bone extending into base; laceration of middle meningeal artery; very extensive bruising of brain; death eighteen hours after accident.*—J. G—, æt. 59, admitted June 11th at 5 p.m. under Mr. Hilton, and died the next day at 11 a.m. He had fallen from a ladder on to his head, was taken up insensible and brought to the hospital. For twelve hours he lay in a state of insensibility; stertor then came on and continued till his death.

Post-mortem examination.—No scalp wound. A fracture was found extending as a curved line across the anterior part of the right parietal bone, and then passing in two directions into the base, one forwards just in front of the lesser wing of the sphenoid, across the orbital plate to the crista galli, the other backwards and downwards through the middle fossa across the lateral sinus and again forwards to the jugular foramen.

The right middle meningeal artery was torn through, as was also the lateral sinus. Between the dura mater and the bone was a large clot of blood; this, however, did not exert much pressure on the brain. The brain itself on both sides was smeared with blood, but more especially on the left. Immediately opposite to the site of injury the middle lobe was most extensively injured, the brain being bruised for a space occupying three or four square inches, and covered with blood-clot. The fluid in the ventricles was slightly bloody, the septum lucidum being broken down, soft, and bruised.

Case 58. *Fracture of left side of skull extending into middle fossa; laceration of middle meningeal artery; much bruising of brain; trephining; death within twenty-four hours.*—A. D—, æt. 50, admitted under Mr. Bryant, March 28th, 1881, at 7.50 p.m., having fallen on to his head from a height of fourteen feet. The patient was unconscious, with laboured, stertorous breathing. Pulse 80. The left side was rigid, the right limp. There was right-sided facial paralysis and internal strabismus. At 9 a.m. the next morning trephining was performed by Mr. Golding-Bird over the site of a wound on the left side; two pieces of bone were taken away, a gush of blood following the removal of the first. A clot of blood was then taken away, and the bone around clipped away. There was profuse hæmorrhage, which was arrested by sponge and tannic acid. The operation was followed by great improvement in the patient's respiration. At 10.30 the breathing was noisy, with laryngeal râles, the pupils dilated, the conjunctivæ insensitive. Death took place at 1.14.

Post-mortem examination.—A fracture could be traced on the left side of the skull from within an inch of the middle line, bending backwards for one or two inches, and then running parallel with and close to the principal groove for the middle meningeal artery, which it crossed obliquely. Passing downwards the fracture ran obliquely backwards across the middle fossa of the skull over the tip of the petrous portion of the temporal bone to end in the suture between this and the occipital bone. The middle meningeal artery was lacerated where the fracture crossed it. Between the bone and the dura mater a considerable quantity of blood was effused forming a thick cake of coagulum; this filled the floor of the trephine wound, which lay about an inch behind the line of fracture. The left hemisphere was very greatly flattened, bulging over towards the right across the corpus callosum; in slicing off the left hemisphere a cavity filled with liquid blood as large as or larger than a pigeon's egg was found within it lying beneath the upper end of the ascending parietal convolution and the convolutions behind this. There was also a considerable extravasation of blood just outside the descending cornu of the left lateral ventricle, with much ecchymosis of the brain-substance around it. The left lateral ventricle con-

tained a dark purple fluid, and the fluid in the right lateral ventricle was also slightly blood-stained. The heart weighed 17 oz., the left ventricle being greatly hypertrophied. The kidneys were granular, with a very wasted cortex.

Case 59. *Extensive fracture of left side of skull running down into base; laceration of middle meningeal artery; much bruising of brain.*—J. E—, æt. 61, admitted April 30th, 1868, under the care of Mr. Birkett, having fallen on to his head and right side, from a height of four feet. He was able, with assistance, to walk into the surgery. There was a small scalp wound on the right side; this was dressed and the patient was about to leave the hospital when he became unconscious. Shortly after, when admitted, he was quite unconscious, lying on his back, his limbs rigid, more especially the lower ones. His breathing was heavy and stertorous. Mr. Birkett laid bare the bone at the site of injury, but no fracture could be detected.

May 1st.—A good deal of bleeding had taken place, during the night, from the wound. The breathing was now quick and stertorous, the right pupil still more dilated, and the patient in a comatose condition. The urine contained albumen. Death took place at 5.30 p.m.

Post-mortem examination.—The left side of the skull was extensively fractured, the parietal and squamous part of the temporal being involved, and a fissure running down into the middle fossa, continuous with the above injury of the vault. The dura mater was lacerated considerably on the right side, the middle meningeal artery being here torn open. The clot of blood extravasated weighed about two ounces, it was dry and firm. The tympanum on the right side appeared to contain blood. The apex of the right temporo-sphenoidal lobe was much bruised, the under surface of that on the left side slightly so.

Case 60.[1] *Fracture of left temporal bone passing extensively into base; laceration of branch of middle meningeal artery on right side and, without fracture, leading to extravasation inside dura mater; extensive bruising of both temporo-sphenoidal lobes.*—J. M—, æt. 21, admitted under Mr. Bryant, May 28th, 1876,

[1] There is no surgical report of this case.

and died the next day at 2.30 a.m. He had fallen down or been knocked down, and struck the side of his head. A heavy muscular young adult. Left mastoid region bruised. The skull was fractured extensively on the left side and in the basal fossæ. Thus a fracture starting behind the ear, in the temporal bone, extended into the middle fossa forwards to the anterior through the wing of the sphenoid, backwards across the roof of the tympanum and then across the petrous part of the temporal to the posterior fossa. The left temporo-sphenoidal lobe was much bruised, but not nearly as much as its fellow. Here the convolutions were extensively pulped, and the fossa lined by a considerable thickness of clot. On scraping this away carefully a branch of the middle meningeal was found to be torn. How this occurred it is difficult to say, as there was no fracture whatever on this side. The vessel was lacerated towards the brain and not towards the skull, the clot being *inside* the dura mater. Besides these injuries a large extravasation had occurred in the grey matter at the upper part of the floor of the fourth ventricle. Numerous isolated extravasations were found throughout the pons, together with small ecchymoses, on other parts of the surface of the brain.

Remarks.—With this case, in which the middle meningeal extravasation took place inside the dura mater, may be compared Case No. 66, p. 250, in which, while some blood was found in the usual place, some had found its way, through a minute rent in the dura mater, into the cavity of the arachnoid.

Case 61. *Fracture of left side of vault, not involving base, with rupture of middle meningeal artery; much bruising of brain.*—J. D—, æt. 46, was admitted under Mr. Birkett's care August 5th, 1862. While walking on a plank carrying a load he had fallen about five feet, striking his head against some bricks. When brought in he was found to have incomplete paralysis of the right side. He never became sensible, but could be roused, and was very irritable when interfered with. He passed his excreta voluntarily. There was never any well-marked stertor. The patient gradually sank without convulsions, and died on August 8th.

Post-mortem examination.—Some effusion of blood in left

temporal region. Fracture near lower and posterior angle of parietal bone, which traversed the groove for the posterior division of the middle meningeal artery, in which a small hole admitting an average-sized bristle was found. Spreading around and upwards from this hole were about two ounces of coagulum quite adherent to the bone and dura mater. The anterior half of the left side of the base of the skull was blackened as with bruising, especially over the tympanum and internal ear. Just over the left orbit another fracture, very small and quite isolated, was found; this implicated the orbital plate of the frontal bone and corresponded with some slight ecchymosis in the orbit. The under aspect of the left anterior and middle lobes of the brain was lacerated, softened, and almost pulpy, full of spots of ecchymosis. The subarachnoid space was full of blood.

Remarks.—As a rule ecchymosis of the orbit after a severe blow on the head would be held to point to fracture of the anterior fossa. Mr. Hutchinson has drawn attention to the fact that such fractures may be extremely slight and easily overlooked. Thus in his 'Clin. Surg.,' vol. i, p. 179, in describing (fig. 3) fissure-fracture of roof of orbit, he writes:—"This sketch illustrates what is a not uncommon consequence of severe blows on the back of the head—a fissure-fracture of the roof of the orbit. In this part the bone is in many subjects extremely thin and delicate, and may break from a degree of violence insufficient to cause fracture elsewhere. I have, in many cases in which patients had died after concussion of the head, but in consequence of lesions elsewhere, found the orbital plates of the frontal bone on one or both sides showing irregular lines of fissure. Usually a little hæmorrhage under the periosteum is present to draw attention to the part, but in some cases, unless the membrane be stripped up and the bone carefully inspected, the lesion may easily escape notice. Often there is a little blood beneath the bone as well, and these are the cases in which ecchymosis is sometimes noticed in the upper eyelid, although no bruise has been inflicted in the part, and the injury has been received solely at the back of the head."

Case 62. *Fracture of left side of skull extending into base; laceration of middle meningeal artery; great bruising of brain;*

life prolonged upwards of eleven days.—D. M—, æt. 58, admitted under Mr. Cooper Forster December 4th, 1875, died on December 15th. He had fallen seven feet off a brick wall on to the back of his neck, and was insensible for about three quarters of an hour.

December 7th.—Marked rigidity of limbs. Patient has been unconscious since admission.

10th.—Had nineteen fits during the night. Left eyelid more tightly closed than right, left angle of mouth drawn. Right side less moved than left.

11th.—Had about twenty fits during the night, used both arms during them. Right side of body flaccid, left rather rigid.

The patient sank on the night of the 15th.

Post-mortem examination.—Fracture on left side of skull extending a little way on the calvaria, more extensive at the base. On the calvaria it isolated a wedge-shaped bit of bone which projected slightly on to the dura mater. At the base the fracture passed backwards across the superior border of the petrous bone, extending into the jugular foramen, from which it passed as a fissure across the cerebellar fossa to the foramen magnum.

A flat cake of black blood was firmly adherent to the outer side of dura mater, the left hemisphere being much flattened by it. Bristles passed into the middle meningeal artery showed that two of its branches were cut through. On one of the lacerations a thin splinter of bone lay. All parts of the arachnoid cavity were blood-stained. The left lobe of the cerebellum was bruised with hæmorrhage into its substance for the depth of an inch. Left side of brain at base about the junction of the middle and posterior lobes was also deeply bruised to the depth of three quarters of an inch. Some parts of it were of a tanny-brown colour, and softened, others hollowed out by clot into cavities. There was a little bruising of the right side of brain, but this was comparatively superficial.

Case 63. *Fracture of right side of skull running down into base; extravasation from middle meningeal; bruising of brain; death within forty-eight hours.*—J. T—, æt. 49. Admitted May 12th, 1875. He had been picked up the previous night in the

street by the police, and being thought to be drunk was locked up. In the morning, being found to be unconscious, he was brought to the hospital. On admission he was still unconscious, with stertorous breathing. The pupils acted sluggishly, if at all; both were equally dilated. Pulse small, 130; resp. 40; temp. 103°. Rigidity of muscles marked in right arm. Urine passed involuntarily. Some swelling superficial to right temporal muscle. A crucial incision was made by Mr. Davies-Colley over this swelling; no fracture found. Trephine applied. Clotted blood found superficial to dura mater; portions of this were removed after enlarging the trephine-opening with bone-forceps. Dura mater uninjured. Patient was thought to be somewhat improved, especially in respiration, after the operation, but he never recovered consciousness and died at 7 p.m. on May 13th.

Post-mortem examination.—On removing the calvaria the right side of the skull was seen to be fissured, the line of fracture lying behind the site of the trephining wound. It ran upwards and backwards to the vertex, and downwards and forwards across the middle fossa of the base to terminate in the foramen spinosum. There was a good deal of clotted blood outside the dura mater, and a cake-like mass inside compressing the brain. The fracture crossed the line of one of the branches of the middle meningeal artery, but it could not be made out that it was wounded. The brain was bruised opposite to the fracture and also on the under surface of the middle lobe on the right side, and of the middle and anterior lobes on the left.

Case 64. *Fracture of skull with separation of coronal suture on left side; middle meningeal hæmorrhage; trephining; hæmorrhage persistent, but arrested by ligature of external carotid; death within twenty-four hours of the injury; much bruising of brain.*—F. F—, æt. 51, was admitted October 30th, 1877, under the care of Mr. Howse. He had fallen out of a waggon, about ten feet, on to his forehead, and was immediately brought to the hospital. When admitted there was no evidence of paralysis, the man was heavy and drowsy, but was sufficiently sensible to answer questions. There was much effusion under the scalp. Some bleeding had taken place from right nostril,

none from ear or mouth. The pupils were normal. Pulse slow and laboured.

At 12.30, noon, the insensibility had increased, the patient being now quite unconscious, with slow and stertorous breathing. Right hemiplegia was present with some amount of spasm. At 2 p.m. Mr. Howse trephined; a large clot of blood was found under the anterior superior angle of the left parietal bone, and was in large part removed. There was a great deal of hæmorrhage during the operation. The right arm and leg were moved once, but still remained very rigid.

About three hours after this operation the bleeding was so great that another piece of bone had to be removed just below the former, in fact adjoining; several branches of the middle meningeal were tied, but as this failed to arrest the hæmorrhage, the external carotid was ligatured in the course of the evening and all bleeding then stopped.

Death took place the next morning, October 31st, at 8.45 a.m.

Post-mortem examination.—The left parietal was separated from the frontal bone at the coronal suture. The right was also separated about an inch, and a fracture ran obliquely backwards for about three inches across this. The bone was not depressed. Some clotted blood still remained upon the dura mater on the left side. The under surface of the left middle cerebral lobe was much bruised to the depth of about half an inch.

Case 65.[1] ***Fracture of side and base of skull involving anterior and middle fossæ; middle meningeal hæmorrhage; trephining; profuse bleeding; relief of compression; death, with meningitis, fifty hours after the accident; bruising of brain.***—A man aged 43 having fallen a height of six feet, striking his head, was admitted immediately into Guy's Hospital. When seen shortly afterwards by Mr. Symonds he was in a totally insensible condition, with right hemiplegia, a pulse of 52, and still falling. He had two abrasions on the left temporal region, and a large extravasation of blood. Though there had been no con-

[1] The notes from which this case was taken were read by Mr. Symonds at a meeting of the Clinical Society, Oct. 9th, 1885; 'Brit. Med. Journ.,' Oct. 17th, 1885.

scious interval Mr. Symonds immediately trephined on account of the hemiplegia and deepening coma. The site selected was rather posterior to that usually chosen, as here the chief injury appeared to have been received. On elevating the disc of bone a pulsating clot was exposed and removed. The bleeding was profuse, and to reach the laceration a great deal of bone was removed by Hoffmann's forceps, two loose pieces of the sphenoid being found. Two lacerations were found in the vessel; one was closed by underrunning with fine gut, the other by completing the division of the vessel and twisting both ends. The bleeding, however, still continuing, and the bone having been incised to the base, the hæmorrhage was finally arrested by underrunning the artery with a piece of the dura mater, and making traction on the ligature carried out of the wound, and by a pair of torsion forceps pushed down to the farthest accessible point and given a half twist. The operation altogether lasted two hours, and the man lost much blood. Recovery was immediate. As soon as the clot was removed, the pulse rose from 43 to 64, and the muscles of the right foot moved; at the conclusion of the operation the man could move his right arm and leg, and give his name and address. The next day he answered all questions and spoke rationally, and seemed to have completely recovered his consciousness. The same afternoon he became restless, and finally delirious; coma supervened, the temperature rose gradually, reaching 104·8° shortly before death, which occurred fifty hours after the accident.

Post-mortem examination.—The dura mater over the exposed area was yellow and purulent, and there was general congestion. The temporo-sphenoidal lobe on the left side was bruised, as was the cerebellum. The fracture ran from the site of the operation to the wing of the sphenoid, and then divided into two branches, one running over the orbital plate to reach the cribriform plate of the ethmoid, the other reaching the same point after traversing the optic foramen and sphenoidal fissure.

Remarks by Mr. Symonds.—His main object was to call attention to the paucity of information upon the best method of dealing with the bleeding vessel, and to suggest a resort to compression of the carotid from the moment when a case was

seen, and to its ligature, should, after trephining, other means fail to arrest the bleeding. Though no mention was made in the leading works of this method of arresting the hæmorrhage, he had no doubt the idea had occurred to others before it had to him, in connection with this case, two years ago. Such severe hæmorrhage was not often encountered, and Mr. Symonds suggested that perhaps the loss of the local pressure of the cranial contents, owing to the non-recovery of the brain, might partly explain it in this case. To the severity of the operation, to its great prolongation, and to the loss of blood, he attributed the fatal meningitis, and he did not think the result affected the average success of trephining.

Case 66.[1] *Fracture of side of skull involving base; middle meningeal hæmorrhage finding its way into the cavity of the arachnoid; extensive ecchymosis of brain; death sixty hours after the accident.*—A man of middle age was admitted into St. George's Hospital after having fallen, as it was supposed, from his horse. There was some ecchymosis of the right eyelids, without evidence of any blow on the part. The patient could at first just mention his name, but soon became incapable of answering any question, though he muttered some unintelligible words, and struggled to cover himself with the bedclothes if he was disturbed; he passed his water and motions unconsciously, but was sensible to touch and moved all his limbs instinctively; he had no palsy of the face, and the muscles of the arms—especially the left—were in a permanent state of spasm, when not otherwise called into action; the pulse was under 60, and laboured; the respiration partially stertorous, and the pupils of both eyes contracted and insensitive to light.

There was from these symptoms evident laceration of the brain, not so deep as the corpora striata or thalami, as there was not any paralysis; there was also internal hæmorrhage, causing moderate compression, and probably a fracture of the base of the skull, not across the tympanum, as there was no blood or other discharge from the ear, but perhaps anterior to the petrous portion, so as to allow blood to be effused into the orbit and eyelids.

[1] 'Path. Soc. Trans.,' iii, p. 232.

To prevent further hæmorrhage he was bled from the arm, which improved the breathing for a time, but the symptoms of irritation and compression continued. On the third day some ptosis of the right eyelid was observed; he became very restless, and was with difficulty kept in bed; then he became more quiet, and died on the 7th March, nearly sixty hours after the injury.

On removing the integuments great ecchymosis was found in the substance of the right temporal muscle, arising from a fracture of the right temporal fossa. On removing the calvaria a good deal of blood was found between the dura mater and the bone on the right side, and a clot of considerable size was found within the dura mater covering the middle of the cerebellum, and extending towards the base of the brain, where there was a good deal—perhaps two or three ounces—of blood. The bottoms of both middle lobes were lacerated to the depth of an inch, and softened for some distance, and there were very many small bruises and spots of extravasated blood in each lobe of both hemispheres, the largest of which was at the upper and back part of the posterior lobe of the left side, which was bruised to the depth of about a quarter of an inch. From the anterior inferior angle of the right parietal bone a fracture passed downwards and forwards across the sphenoid fissure, and thence, through the lesser wing of the sphenoid bone and body of that bone, to the horizontal plate of the ethmoid bone, an additional small fracture passed backwards from this part to the sella turcica.

Some blood was found in the orbit, but not among the muscles, and the extravasation in the eyelids had proceeded from some blood passing from the temporal muscle over the edge of the orbit.

Remarks by Mr. Cæsar Hawkins.—The points of interest were that the fracture of the temporal bone had ruptured a large branch of the middle meningeal artery, the blood not being extravasated between the bone and dura mater only, as is sometimes the case, or making its way through the ear, as is also sometimes seen, but having chiefly escaped through a rent of the dura mater about half an inch long into the cavity of the arachnoid.

Case 67.[1] *Extensive fracture of both sides of skull, involving base; middle meningeal extravasation on both sides; trephining; death fifteen hours and a half after the accident.*—An Irishman aged 40 was admitted into the London Hospital, under the care of Mr. Luke, April 28th, 1854, having an hour before fallen from a ladder, about two stories high, into a mortar-mixing trough. When admitted his manner was confused, although when pressed to speak he gave his name, occupation, and address. He appeared to be suffering under commencing symptoms of compression, and this was Mr. Luke's opinion. Three hours after admission Mr. Ward was asked to see him, and found the usual compression symptoms remarkably defined, rapid and gasping respiration, gurgling in the throat, frothing at the mouth, both pupils fixed and dilated (the left one more so than the right). This state of things had rapidly come on. On making a careful examination of the cranium no external abrasion even could be detected on the integument, but over the prominent part of the parietal bone its surface appeared more raised than elsewhere, and it pitted on pressure. A large crucial incision was made and a fracture exposed running upwards from the temporal bone. Blood oozed distinctly from beneath the fracture. The crown of a trephine was applied, and part of the fracture was included in its middle. On the removal of the bone a clot of blood concealed the dura mater; this was removed, and a probe introduced beneath the cranium and more coagulated blood taken away. The trephine opening was enlarged by Hey's saw. The flattened end of the probe was again introduced, but wherever it passed it met with no resistance, in consequence of the great detachment of the dura mater from the bone. On the completion of the operation blood oozed freely from the wound. The patient was relieved by what had been done, the respiration being easier and less frequent, but with this exception there was no change in the symptoms. These in the evening had regained their original intensity. Mr. Critchett enlarged the wound in the bone, more clot was taken away, but the symptoms were unrelieved. The man died fourteen and a half hours after admission.

Post-mortem examination.—The integuments over the prominent part of the left parietal bone, though not raised above

[1] 'Path. Soc. Trans.,' v, p. 238.

the level of the remainder, had a little blood infiltrated into them. The fracture was not in any way starred, but it described an interrupted curve, which might be said to commence on the right side, at the angle of junction of the squamous with the petrous bone, and to be directed upwards and backwards through the former to the upper and back part of the parietal bone, to within an inch and a half of the sagittal suture. Here it was interrupted by unbroken bone as far as to within half an inch on the left of the suture, and was then continued downwards and forwards, involving the corresponding parts of the left parietal and squamous plates and from the latter position into the outer part of the apex of the petrous portion. The dura mater under either parietal bone was detached to exactly the same extent, which represented an area about equal to the palm of the hand; on the right side but a few scattered portions of blood separated the membranes from the bones, but on the left, where no operation unfortunately had been performed, a large coagulum had collected, depressing the dura mater to a considerable extent. On washing away the blood, a rent was distinctly observed in two of the principal branches of the middle meningeal artery.

Remarks by Mr. Ward.—The case was particularly interesting in consequence of the corresponding detachment of dura mater on either side, as regards extent and position, and the interruption of the fracture, near its middle. The injury of the right side of the cranium (there having been evidence here of local injury in the puffy condition of the scalp, &c.) might be regarded as arising from direct, that on the left from indirect violence, or the contre-coup.

Case 68.[1] *Railway injury; extensive compound fracture of skull, with depression of a large portion of left parietal bone, extending to base; middle meningeal extravasation; trephining; erysipelas; arachnitis; death eight days after the injury.*—J. C—, æt. 35, a porter on the Great Eastern Railway, was knocked down by an express train January 9th, 1871. When brought to the London Hospital at noon he was insensible, with cold extremities and dilated pupils. He had a convulsive attack. There was a small wound in the scalp above and in

[1] 'Med. Times and Gazette,' 1877, vol. ii, p. 233.

front of the left ear, and the finger introduced into the wound and passed upwards could detect the fracture easily. The line of fracture was extensive, and sweeping in a semicircle downwards and forwards to the external angle of the left orbit, and backwards to the occipital bone. The upper edge projected from two to three lines, and a large portion of the parietal bone was wedged in under this projecting edge. There was some bleeding from the wound, and a little from the nose, but none from the ear.

For some hours he was very restless, tossing about and talking incoherently. At 4 p.m. he recovered consciousness, recognised his wife, and answered questions intelligibly. He appeared to be very drowsy. He could grasp a hand held out to him with both his hands, but less powerfully with the right hand than with the left. Sight and hearing were good. Both pupils were dilated, and both acted on being stimulated, the left less than the right. The patient was seen by Mr. Hutchinson in consultation with Mr. Rivington, and it was considered advisable to use the trephine for the purpose, if possible, of elevating the depressed portion of bone, and affording a free exit to the blood which had, in all probability, been poured out between the bone and dura mater from a wounded branch of the middle meningeal artery. Mr. Rivington enlarged the wound, and applied the trephine over the sound bone close to the fracture, at the point of greatest depression. Sufficient bone having been removed with the trephine and Hey's saw, the elevator was introduced and the depressed fragment freed as far as possible. Arterial blood welled up when the bone was raised. The wound was sponged out with carbolic acid lotion, and a piece of lint dipped in the same laid over it. A day or two after the wound was attacked with erysipelas, which spread to the face and neck, and was accompanied by fever and delirium. There were no symptoms of compression, no paralysis of any part; arachnitis was suspected. The patient died on the 27th, eight days after the operation.

Post-mortem examination.—A large semicircular portion of bone, including the lower part of the parietal, the upper part of the great wing of the sphenoid, and the squamous portion of the temporal was found to be detached, except posteriorly. The dura mater was sound, but a flattened clot lay between it

and the bone above the middle fossa. Lymph was found on the visceral arachnoid, and serum in the subarachnoid space. There was a fracture across the base of the skull, extending from one petrous bone to the other, through the left foramen rotundum and the sella turcica.

Case 69. *Compound depressed fracture of right side of skull passing into base (middle fossa) ; injury to a branch of middle meningeal artery ; extravasation slight ; injury to brain very slight ; fractured spine ; plugging of a renal vein ; life prolonged over eight days.*—J. S—, æt. 34, was admitted under Mr. Bryant September 18th, 1874 ; died September 27th. He had been knocked down by a train, which struck his head. There was a compound depressed fracture of the skull with the external wound just over the coronal suture. Evidence of injury to spine and kidney. Fracture of rib, emphysema. The symptoms all along pointed to the spinal injury, no marked head-symptoms being noted up to death.

Post-mortem examination.—Depressed fracture of vault near coronal suture on right side. Both tables driven in and the inner spiculated. Dura mater not wounded here, but its cranial surface for the extent of a square inch was covered by a layer of lymph. Its cerebral aspect was discoloured and brick-red from altered blood, as was also the brain on this side, though it was not otherwise damaged. The fracture ran vertically from the vault into the middle fossa, crossing a branch of the middle meningeal. The wall of the skull had here a thin layer of blood covering it. Brain healthy, save for a slight laceration of the grey matter of one convolution. Fracture of ninth to tenth dorsal vertebræ. Plugging of left renal vein. Gangrenous condition of kidney.

Case 70.[1] *Extensive fracture of skull, vault, and base ; meningeal hæmorrhage in frontal region, from branch of middle meningeal (?) ; no symptoms of compression ; death on eighth day from fractured spine.*—The patient was a woman aged 38, of drunken, dissipated habits, who had fallen from a window thirty feet high. On admission to the Westminster Hospital under the care of Mr. Holt September 15th, 1858, she was suffering

[1] 'Path. Soc. Trans.,' x, p. 59.

from all the symptoms of concussion. A tremendous scalp wound, which ran in a direction from before backwards, almost peeled the right side of the head. In the course of five or six hours she had pretty well rallied, and it was found that all sensation was lost below the ensiform cartilage. Twenty-four hours after admission the intercostal muscles were powerless, and the breathing was performed only by the diaphragm. There was complete paralysis of both arms. Consciousness had returned completely, now that the state of concussion had passed away. No remarkable change of the symptoms ensued during the next four or five days. On the eighth day after admission, however, she sank rapidly, the pulse becoming quicker and more feeble, the breathing hurried, deglutition difficult, and the sphincters paralysed. Death took place on this, the eighth day from the occurrence of the accident.

Post-mortem examination.—There was a fracture of the cranium which only partly corresponded with the position of the wound in the scalp. Starting from a point opposite the middle of the sagittal suture and about a quarter of an inch to the right of it, the crack extended obliquely across, so as to join the coronal suture about a quarter of an inch to the right of the middle line, running through the left coronal and the suture between the temporal and the great wing of the sphenoid, splitting into the foramen ovale, winding round the apex of the petrous portion of the left temporal, and extending into the basilar portion of the sphenoid; the edges of the coronal suture were a great deal exposed, and the interval filled with clotted blood. A large clot of blood was found between the dura mater and the left half of the frontal bone, which seemed to have been formed by a rupture of the meningeal artery. The ventricles contained no fluid, and the rest of the brain was healthy. The body of the sixth cervical vertebra was smashed into many pieces. The central grey matter of the cord, for the distance of an inch, was in a state of red softening.

History of the Case and the Original Violence or Accident.

We find here the following facts:

Instances of how slight the violence may be.—This fact, of great importance as showing how treacherous, as it were, somehead injuries are which, apparently very trivial at their onset, yet produce ultimately, and often speedily, fatal results, is seen in Cases 1, 2, 3, 4, where the extravasation was caused by a blow with a cricket-ball, slight falls with the head against a wall, and a fall of two feet six out of a swing.

Instances of violence applied more locally and directly are given in Case 5, a blow with a spade; Case 16, a blow with a poker; Case 15, one with a brickbat; Cases 12, 13, and 14, musket-ball injuries of the skull. Cases in which the violence was also direct, but far more severe, are Nos. 52 and 56, in which the lesion was due to a shell wound, and the fall of a heavy beam of wood upon the head respectively.

Far more frequently the injury is due to falls, and usually of a serious character. Thus Cases 6, 23, 29, 36, 37, 64 were due to falls off driving seats, off waggons, omnibus, &c. In Cases 10, 18 and 33, the fall was through a trapdoor, in 9 and 31 into ships' holds. In Cases 7, 41, 42, the fall was received during fighting. In 46 and 51, the patient had fallen off a scaffold; in 30 and 38, he was picked up out of an area. In Cases 35, 68, 69, the injury was due to falls from or being knocked down by a train.

Symptoms and Other Evidence of Middle Meningeal Extravasation.

The writer has taken these in what he believes to be the order of their value, viz.

A. Interval of consciousness or lucidity.
B. Condition of limbs, as to hemiplegia, paraplegia, rigidity.
C. Condition of the pupils.
D. Character of the pulse.

E. Unconsciousness increasing and passing into coma.

F. Character of the respiration.

G. State of the scalp, and of the cranial bones when sawn in trephining (Abernethy).

In a recent contribution to this subject by a German surgeon, Dr. Wiesman, of Zurich,[1] the symptoms given as pointing to middle meningeal hæmorrhage are as follows :

(1) Interval of consciousness between the concussion and the appearance of pressure symptoms, somnolence, stupor, coma, death. Compression symptoms may occur at any time from fifteen minutes to eleven days after the commencement of the hæmorrhage.

(2) Hemiplegia on the side opposite to the injury. This is explained by the position of the artery exactly over the motor centres for the arm and leg. Isolated paralysis of the leg is never observed, but only paresis when the arm is paralysed, or both may be similarly affected at once. Convulsions may precede the affection.

(3) Changes in the pulse—infrequency and hardness, generally increasing; sometimes the pulse becomes frequent at the last (paralysis of the pneumogastric).

(4) Anomalies of respiration—slow, embarrassed, stertorous breathing.

(5) Vomiting.

(6) Changes of the pupil; generally speaking dilated pupils point to considerable pressure; the pupil on the side of the hæmorrhage is dilated and does not react.

(7) Unilateral impairment of sensation (observed in seven of the cases).

(8) Aphasia.

(9) Disorders of the bladder and rectum.

(10) Automatic movements, and lying always on one side (three cases).

(11) Rise in temperature (the highest being 42·6° C.)

The diagnosis is sufficiently accurate if the first four of these symptoms are present, whether there be a lesion of the skull or not, or even if there be one on the opposite side.

Aphasia points to an extension of the hæmorrhage towards

[1] 'Deutsche Zeitsch. f. Chir.,' Bd. 4, Heft. 1 and 3; 'Annals of Surg.,' Dec., 1885, p. 502.

the front,[1] disorders of sensibility to one behind, paralysis of the third pair of nerves[2] to one towards the base of the skull. Crushing of brain matter, inflammatory conditions, even congestive hyperæmia may cause errors of diagnosis.

A. *The interval of consciousness or lucidity.*

It is well known that between the time of the concussion or stunning of the patient by the original violence and the supervening of symptoms of compression due to the blood which is now effused, there often exists an interval of more or less marked consciousness, the value of which has long been recognised.

In examining the cases in this paper we find that the following results come out with regard to the above symptom, the importance of which may be said to outweigh the others put together. To begin with it is by no means always present, and when present it is not necessarily well marked.

In some cases, thirty-two out of sixty-three,[3] the interval is well marked. In a second class it is but little marked, and may easily be overlooked altogether. In a third and last set of cases the interval is never present at all, the severe concussion inflicted by the injury having passed on without break of any kind into compression and coma.

The writer proposes to examine these different cases somewhat in detail.

(1) *Cases in which the interval of consciousness or lucidity is well marked.*—This was so in the following thirty-two cases, viz. 1, 2, 3, 4, 5, 6, 7(?),[4] 8, 9, 10, 11, 12, 13, 14, 17, 20, 24, 25, 26, 27, 28, 31, 33, 35, 36, 37, 42, 47, 49, 51, 52, 59.

We shall, perhaps, gain the best idea of what is meant by a

[1] Woodcut 1, p. 153.

[2] Mr. Hutchinson's explanation of this is given, p. 272.

[3] While this paper is based on seventy cases of middle meningeal hæmorrhage, in seven of these there is no evidence from which any conclusion about the above interval may be drawn.

[4] While nothing is stated definitely in this case, it is said that "nothing serious was thought of the fall, nor any medical man sent for;" an "interval" was, therefore, probably present.

well-marked interval by examining into (*a*) how long this period of consciousness or lucidity lasted, and (*b*) what the patients were able to do in it, and these had best perhaps be taken together.

In several cases the interval was an hour or more. Thus in Mr. Howse's case, No. 9, p. 170, the boy remained conscious from 6 p.m. to 10 p.m., or four hours. In one of Mr. Hutchinson's, Case 33, p. 215, the interval was even longer, the boy was admitted about noon, apparently only shaken by his fall, and ailing "so little that the question was raised as to whether it was worth while taking him in." He remained sensible up to 6 p.m., dying about 8.30 the same evening. In one of Mr. Cock's cases, No. 37, p. 223, the interval was half an hour; the patient, a commercial traveller, having been thrown from his gig on to his head, got up and walked about for half an hour, when he became confused and staggered. He went into a shop and was supposed to be intoxicated, and at length becoming perfectly insensible was taken to the hospital.

In Cases 1 and 2, the interval must have been an hour or upwards, as in the latter the child was able to eat her dinner immediately after her fall, and in the former, the boy after the blow with the cricket-ball on the temple, came home about 8, was seen by a medical man at 9, soon after which he became "delirious," though in intervals of restlessness he "expressed great anxiety that the boy who threw the ball should not be blamed."

The above are instances of consciousness or lucidity well marked and lasting hours, an hour, or half an hour. Let us now contrast with these instances also well marked but very much shorter. Thus in Case 5, after a blow with a spade over the anterior inferior angle of the parietal bone, the patient was brought to St. George's Hospital with a depressed fracture, but no cerebral symptoms whatever. Shortly after he became heavy and stupid, and coma was gradually supervening when Mr. Keate elevated the depressed bone. In Case 7 the interval was also short, though well marked. A young man when fighting had been knocked down and stunned; he speedily recovered his senses and was brought to the London Hospital complaining of pain in his head. As he walked along the ward he began to stagger, and with difficulty reached his

bed, his breathing became stertorous, and he was evidently hemiplegic.

It is thus shown that the duration of the interval may vary from a few minutes to several hours.[1] This duration must depend upon the size and number of the branches of the middle meningeal which are opened, it making all the difference whether one or two large branches are opened by the fracture, or a number of minute ones torn by the violence which separates the dura mater from the bone (*vide supra*, p. 160).

The rate at which the blood is poured out, as well as its amount, will also influence the duration of the interval, this being affected by whether the patient keeps quiet or not, receives food, stimulants, &c., the amount of any previous collapse, any severe preceding hæmorrhage from a scalp or other wound, as in Case 10, p. 174, where the patient, after a fall upon his head of seventeen feet, received a severe scalp wound, from which he bled profusely, the amount producing syncope, and no evidence of compression appearing for nine hours.

As instances of what patients can do during the interval of lucidity or consciousness the following may be mentioned: boys come home after receiving the fatal injury and describe what has happened; a child eats her dinner; patients, after having a scalp wound dressed, are able to walk away from the hospital by themselves, or with the help of a policeman, this being one of the ways in which one of the most fatal of all head injuries is repeatedly overlooked, owing to, perhaps, the slightness of the violence and the delay of compression symptoms.

In other cases a boy may appear so well (after a fall through a trapdoor) that the question is raised as to whether it is worth while taking him in, "the only appreciable symptom being a bruise in the left temple." A drayman, after a fall from his driving-seat, is able to get up on his box and drive some distance. Soldiers, after bullet or shell wounds of skull, are able to walk out of the fight to the surgeon in the rear, one man, Case 52, p. 235, walking three miles, accompanied by a comrade.

[1] In the article by Dr. P. Wiesman, already referred to, and containing 278 cases, the onset of compression symptoms was found to take place at any time from fifteen minutes to four days after the commencement of the hæmorrhage.

What a patient can do during this interval may be of great importance not only in the history and diagnosis of the case, but from a medico-legal point of view also. About two years ago, when this article was commenced, the writer came across the following case, he believes, in one of the journals. Unfortunately he omitted to make any note of it, but the main facts may be relied on. A man was found in a stable, comatose and dying. Post-mortem examination showed middle meningeal extravasation. The question arose, was this due to assault, a fall in a fit, or a kick from the horse? It was shown ultimately, by putting evidence together, that the man had probably fallen from his cart at a considerable distance from the stable, and thus received the fatal injury, gone home, a distance of several miles, put his horse up, and then fallen down in the coma which only ended in his death.

Another instance of the medico-legal importance of blood extravasated between the skull and dura mater is abundantly given in the next case. While the sheets of this article were passing through the press, the following appeared as the heading of one of the annotations in the 'Lancet,' March 6th, 1886. "The Everton murder. On the 15th ult., Michael Larelle, æt. 16, was tried before Mr. Justice Day at the recent assizes held in Liverpool, for the wilful murder of a man named Maxwell Kirkpatrick, by striking him behind the right ear with a wooden roller, such as is used in timber yards." . . . . . The cause of death being compression of the brain by a clot. The writer communicated with Dr. Ellis, of Liverpool, under whose care deceased had been during the short time (about seventeen hours) which elapsed between the injury and the fatal result. Dr. Ellis promptly and most courteously forwarded the notes of the case which are given below. While the exact source of the blood which was found between the skull and the dura mater, whether the lateral sinus or the middle meningeal artery, must remain doubtful, the case is a most interesting one clinically as well as medico-legally. Thus it affords another good instance, in addition to those already given in this paper, of (1) a fracture of the internal table only and of the damage which such a fracture may cause; (2) dilatation of the pupil on the same side as the clot, and that clot a large one; (3) and this point is perhaps the most important of all, the case, as

Dr. Ellis points out in the following extract from his letter to the writer of this paper, "is interesting as showing how a very serious injury may be received and no apparently serious symptoms ensue for a long time. Here the man had been able to walk (up a steep hill) nearly half a mile to his house, and then another half mile to my house, and a final half mile back, though with assistance; then you may notice that the unconsciousness (or compression) did not come on until 9 o'clock —three and a quarter hours after the attack."

Case 71. *Fracture of right side of skull from a blow with a wooden roller; fracture simple, involving internal table only, but extending into base in right mastoid region; well-marked interval of consciousness lasting three hours or more; then stage of compression, ending fatally about seventeen hours after the injury; large blood-extravasation between skull and dura mater in right temporal and mastoid region? from lateral sinus or middle meningeal artery; some damage to subjacent brain; trial for murder and death sentence.*—Maxwell K—, æt. 43, was brought to my house, Feb. 1st, 1886, by his wife, about 6.30 p.m., having walked a distance of nearly half a mile. He appears a little confused, and tells me that on his way home from work he had been struck a blow on the head—the effect of the blow being that he fell down and became unconscious, but, coming to his senses, was assisted home by a companion.

On examination I found a little swelling on the right side of the head, between two and three inches above and behind the right ear. There was no wound, but blood was oozing from the right external auditory meatus. Suspecting fracture of the base of the skull, I sent him home to bed, and promised to call later.

I called shortly after 9 p. m., and on going upstairs found him unconscious—with stertorous breathing—quite incapable of being roused. This appeared to have come on only a very short time previously, for his wife had only left him, quite conscious, *but sleepy*, about 9. He had vomited several times before my arrival. He was very cold, pulse small and irregular (38 to 44), right pupil dilated, left very contracted. I ordered ice to the head and warmth to the body. I endeavoured to take the temperature, but the mercury did not rise beyond the lowest point to which I could shake the index—

viz. 96°—his temp. was therefore below this. Towards 11 p.m. the breathing became more sighing in character, the pulse somewhat steadier (45 to 55). About twelve midnight the temp. began to rise above 96°, and by 1 a. m. of the 2nd had risen to 99°. The right pupil now became less dilated, the left one much less contracted, and he seemed much easier. By 1.30 a. m. the temp. had become normal, and I left him for the night, sending him a mixture containing Tr. Aconite ♏vj in Aq. ℥vj, ʒj (=Tr. Acon. ♏$\frac{1}{8}$) every ½ horâ, with the idea of checking too great reaction.

At 8 a. m., Feb. 2nd, I again visited the patient and found the breathing full and regular; temp. 106°, face flushed, pulse full and bounding, about 60, nearly regular; pupils both insensible to light and both equally dilated—conjunctivæ injected, and the mouth very dry. Had not recovered consciousness, but had several times passed urine involuntarily. About a quarter of the mixture—Tr. Aconite ♏1¼—had been given and the head was being kept constantly cool with ice.

I was hastily summoned at 9.45; found him breathing deeply and slowly, face dusky, pulse flagging, temp. 107°. He died at 10 a. m., sixteen and three quarter hours after the injury, which had been received about 5.45 p. m. the night before.

Post-mortem examination made at 8 a. m. on Feb. 3rd (twenty-two hours after death).

Rigor mortis well marked.

Body well nourished and very muscular.

Post-mortem ecchymosis on back of neck and shoulders; on removing scalp there was found, on the right side, a small ecchymosis, about the size of a shilling-piece, situated in the skin about three inches behind and slightly above the level of the outer meatus of the ear; but there was no division of the skin.

On removing the skull-cap a large blood-clot was found occupying the central third of the right side of the brain, the clot weighing, it was judged, about six ounces, and about sufficient in quantity to fill a TEA-cup. The clot was situate external to the dura mater. The brain beneath the clot, after removal of the dura mater, was found to be in a somewhat pulpy, disintegrated condition. No wound or injury of the meningeal arteries could be found.

A simple fracture (of the inner table only) of the skull was found running obliquely from above the right ear downwards and backwards as far as the lateral sinus, hæmorrhage having taken place apparently from the mastoid bone.

Contents of thorax and abdomen were perfectly healthy.

Conclusion arrived at.—"That deceased died from compression of the brain from hæmorrhage, the result of a fracture of the skull."

(2) *Cases in which the interval of consciousness or lucidity was but little marked, and might have been overlooked altogether.*—The interval being noticed more or less distinctly in sixty-three out of seventy cases, it was but little marked in ten of these, viz. 16, 29, 32, 34, 56, 61, 64, 66, 67, 68. As these cases are, with those in group (3), very likely to be mistaken, owing to the evidence, which is always relied on in these cases, being easily overlooked or absent, it will be worth while to pay attention to some of them carefully.

In Case 27, a boy having fallen off a wall, was brought, an hour later, to the hospital. Since the accident he had not been thoroughly sensible, and was very much inclined to sleep.

In Case 34, a man, after a fall, rapidly showed signs of compression, but the facts came out that when first taken up after his fall he managed to stand. When admitted he resisted efforts at examination strongly, and although he never spoke, often seemed on the point of doing so. In Case 56, it is said that the patient was insensible and in a state of collapse, but without the symptoms of compression, making an effort to sit up, though apparently unconscious when spoken to. In Case 61, p. 243, the patient never became sensible, but could be roused, and was very irritable when interfered with. In 64, the man was heavy and drowsy, but sufficiently sensible to answer questions. In 67, the patient's manner was confused, although when pressed to speak he gave his name, occupation, and address.

(3) *Cases in which the interval of consciousness or lucidity is absent from first to last.*—These cases are unfortunately more numerous than would be supposed, considering how much the interval is talked about, and how much stress is laid on it. Out of sixty-three cases in which the interval is alluded to, it was

absent in twenty-one, viz. in Cases 15, 18, 19, 21, 22, 23, 30, 38, 39, 40, 41, 43, 45, 46, 53, 54, 55, 57, 58, 63, 65.

The explanation of this frequent absence may lie in—(i) The concussion having passed straight on into compression, owing to (α) the severity of the original violence; to (β) the fact that a piece of bone has been driven in at the time of the blow, as in Cases 15, 18, 21; to (γ) injury having been inflicted on the brain in addition to the rupture or laceration of the middle meningeal artery, of which combination of lesions 55, 57, and several others are instances; and finally to (δ) the extravasation having been immediate and copious, owing to the part of the artery opened being a large branch or near the trunk, and to the co-existing separation of the dura mater being very extensive. Of this such cases as Mr. Bryant's, No. 22, p. 191, are good instances.

(ii) The interval may be absent owing to the drunkenness of the patient. Owing to its frequency this is a matter of great importance, especially in busy hospitals in large towns, where it is by no means a matter of rare occurrence for patients while drunk to become the subjects of middle meningeal extravasation.

And this remark must include not only cases of actual drunkenness, but also those cases in which this diagnosis is made by the police, and they bring up, very likely at night-time, a patient who may be drunk or not, and whose unconsciousness may be due to middle meningeal hæmorrhage or one of many other conditions, but, whichever of these it prove to be, no interval of lucidity has been present.

In saying above that the occurrence of middle meningeal hæmorrhage in drunken patients is by no means rare, the writer has excluded such cases as No. 25, p. 194, in which the patient, knocked down by a cab and brought up by the police, was able to walk out of the surgery on the occasion of his first visit to the hospital. Only such cases as 30, 38, 41, 45, 63, are included in which the patient, whether really drunk or not, was unconscious, and no history of any interval of lucidity could be obtained.

It will thus be seen that out of sixty-three cases of middle meningeal hæmorrhage in which the interval of lucidity is mentioned—

In 32 it was well marked.
In 10 it was but little marked and might have been overlooked.
In 21 it was absent.

63

This conclusion of the writer from the cases which he has collected that the interval of lucidity is absent in one third of the cases is not quite in accord with one of the most leading surgeons of the present day, and one who has paid especial attention to the subject of head injuries. Mr. Hutchinson, who writes as follows in one of his most recent contributions to the subject,[1] thinks thus on the subject of this interval of lucidity :

"It would seem that it is not usual for a large hæmorrhage to occur at the time of the injury, for almost always there is an interval during which the patient is well before the symptoms of compression come on."

Whether or no a larger number of cases than that on which this paper is based prove that this interval is present more frequently, and is well marked in more than one third of the cases, its importance over all the other symptoms put together will always be undisputed. Writing in another place[2], Mr. Hutchinson speaks of it as follows :

"The more carefully we study this group of cases the higher value shall we be inclined to put upon the previous history of the case as a means of diagnosis and the less shall we rely on the symptoms. The importance of an interval of immunity between the accident and the occurrence of symptoms has been long recognised as the chief indication of a ruptured meningeal artery, and it is to this, almost exclusively, that we must still give attention if we wish to diagnose these cases. Unfortunately it is not always that we can get correct statements as to the early symptoms, but whenever there is clear testimony as to complete immunity at first, and the symptoms have come on suddenly and at too early a period for the development of inflammation, then we may with tolerable confidence infer the existence of hæmorrhage."

[1] 'Clin. Surg.,' vol. ii, p. 64.
[2] 'Lond. Hosp. Rep.,' vol. iv, p. 52.

B. *Condition of the Limbs as to Hemiplegia, Paraplegia, Rigidity, &c.*

It is usually taught that middle meningeal extravasation is accompanied by hemiplegia or paralysis of the limbs on the side opposite to the injury. The existence of some form of paralysis, or the condition of the limbs are only mentioned in thirty-seven out of the seventy cases on which this paper is based. In nineteen out of these thirty-seven hemiplegia was present to a more or less well-marked degree.

It must not, however, be looked upon as essential, and middle meningeal extravasation must not be overlooked because hemiplegia is absent, or ill-marked, or replaced by some other condition of the limbs.

At least the following seven abnormal conditions of the limbs may be met with in cases of the lesion of which this paper treats:

(α) Hemiplegia present and well marked.

(β) Hemiplegia present, but little marked.

(γ) Hemiplegia present, but temporary.

(δ) Hemiplegia present, but more marked in one limb than in the other.

(ε) Paraplegia.

(ζ) Absence of any paralysis.

(η) Limbs rigid and twitching.

(α) *Hemiplegia present and well marked.*—In these cases the leg or arm, and usually both, when taken up and let go, fall from the hand as if they belonged to a corpse. Well-marked hemiplegia was present in thirteen out of thirty-seven cases in which paralysis is mentioned at all. While the above shows that hemiplegia is well marked in at least one in three of the cases and needs no further comment, the writer would draw attention to the fact that, occasionally, as in Dr. H. Watson's case, p. 168, the hemiplegia is on the same side as that injured by the fall, the extravasation taking place on the side opposite to that struck.

(β) *Hemiplegia present, but little or ill-marked.*—It is in these cases, which are not uncommon, that the extravasation may

be overlooked. They fall into at least two divisions. In one the hemiplegia is little marked throughout, owing perhaps to some power of accommodation on the part of the brain, or to the circulation remaining feeble owing to coexisting shock from the time of the injury to the moment of death.

Of such little-marked hemiplegia the following are instances: No. 27, p. 197, in which it is stated, "Patient unconscious, but moved her arms and legs feebly when disturbed; no definite signs of paralysis." Case 31, p. 212, "Patient uses his left limbs much less quickly and less vigorously than his right ones. Sensation, however, appears to be good in the left limbs, for when they are pricked he at once moves the others in the attempt to defend himself."

Whenever it is noticed that the movements of the limbs on one side are sluggish, weak, impaired, the following tests should be carefully made use of: whether the patient resists on the surgeon attempting to move the limbs; the power of the grasp, if any; the result of pricking; whether the patient moves either of his hands, and which of them, when the cornea is carefully touched, or the cilia gently pulled.

There is another group of cases in which hemiplegia is ill marked because of brief duration, coming on in these as it does, towards the close of the case, together with a condition of coma and giving but little warning, and leaving but short time for interference.

Thus, in Case 51, p. 234, two hours and a half had elapsed since the fall (seven feet from a scaffold), "when suddenly the symptoms of compression came on, stertor, and paralysis of the right side supervened, and he died in ten minutes."

In thirty-two out of the seventy cases on which this paper is based there is no mention of hemiplegia. After making all fair allowance for incomplete reporting it seems fair to suppose that in a large proportion of these thirty-two cases this important symptom must have been absent. If so this confirms the opinion of Mr. Hutchinson[1] on this subject:

"The occurrence or absence of hemiplegia is a very uncertain symptom. In the rapid cases it is never observed, because the patient rapidly becomes insensible; and in the more slow ones it is usually transitory since the brain mass

[1] 'Clin. Surg.,' vol. ii, p. 64.

accommodates itself to the local intrusion. In the early periods there is probably always some weakness of the opposite limbs, but if such a condition is marked and persists it is much more probable that there is laceration than compression by blood."

(γ) *Hemiplegia present, but temporary.*—This is a very rare condition, but one deserving remark. The best instance of it is seen in Case 31, p. 212, in which there was some hemiplegia of the left side on the first day. Mr. Hutchinson in his remarks at the bedside "pointed out that the man's condition was, for the most part, that of severe concussion, in the stage of but partial recovery from collapse. Thus he was chilly, stupid, and sleepy, and very irritable when roused; but he had one symptom which did not fit with mere concussion, *i. e.* the very decided though partial paralysis of the left arm and leg." The following day he was much better, the hemiplegia had quite passed off, and he had regained full consciousness, the patient dying on the ninth day of pyæmia. Mr. Hutchinson considered that the hemiplegia which was present on the first day and gone on the second, and which never reappeared, was due to the blood-clot. This had probably been rapidly effused, and for a time caused compression of the adjacent hemisphere. In a little time the brain had yielded and accommodated itself to the intruded blood, and the signs of compression ceased.

Another case, No. 16, p. 184, shows that though hemiplegia may be transitory, disappearing for a while, and, as in this case, sensation returning, it may recur with coma and prove fatal.

(δ) *Hemiplegia present, but more marked in one limb than the other.*—This condition does not appear to be a common one though it is possible that more careful records of cases and examination of a larger number will prove its greater frequency. It is probably due to a large extravasation which, either by its greater depth or by its firmer contraction at one spot, which happens to lie over that part of the motor area which is the nucleus for the arm or leg, makes greater pressure on this nucleus than at other spots (see woodcuts 1 and 2).

Instances of this condition are seen in Cases 37 and 38. In the former it is stated that "the right arm appeared more

rigid than the left, and at the same time partially paralysed, as the patient "did not move this limb, while he did the left." In the latter the left arm was weak and almost powerless."

(ε) *Paraplegia.*—This condition was present in five cases, viz. Cases 19, 22, 36, 45, and 52. The first two of these afford probable explanations. Thus in Case 19, p. 187, repeated blows had been received on the head with a whip handle and stick. The skull was trephined first on the right side, then on the left, by Dr. Hill, of Dumfries, at intervals of four days, and clots removed from both sides; after the second operation "the patient instantly looked up like one awakened from sleep, knew and named everybody, and raised his arms, which had been paralytic, over his head."

In Case 22, the patient having fallen from his horse on to his head, "all the limbs were completely paralysed." Mr. Bryant, to whom the writer is indebted for the notes of this case, considers that the fact that the paralysis was general may be explained by the clot on the left side of the brain, large and rapidly effused, having made urgent pressure, through the left side of the brain, upon the right as well.

The same explanation may hold good in Case 36, where during life there was complete general paralysis, and after trephining "a very large clot" was found on the left side. In this case the brain never recovered itself, as after removal of the clot "paralysis and other symptoms remained unaltered."

In Case 45, p. 228, it is reported that "there was general paralysis, but it was more complete on the left side of the body." Here, perhaps, a third explanation may have been present. At the post-mortem examination five and a half ounces of firmly coagulated blood were found between the bone and dura mater, which was pressed in and formed a cavity over the right hemisphere of the brain. The more complete paralysis on the left side may be accounted for by the fact that "on slicing off a portion of the right hemisphere a small recent extravasation of blood was met with in its substance, a little to the outer side of the lateral ventricle."

(ζ) *Absence of any paralysis.*—The writer has already alluded to those cases where hemiplegia has been present, but passed away (p. 269). Absence of any paralysis is a condition

very rarely met with in these cases of meningeal hæmorrhage. Cases 21 and 40 are instances of it. In both it is distinctly stated that, though the patient was insensible, "there was no paralysis." In each case, in Mr. Swain's, which was successfully treated by trephining, and in Sir W. Gull's, which ended fatally, middle meningeal extravasation had taken place. In both there was much blood beneath the scalp; and therein lies the explanation of the absence of all paralysis. The blood as it leaked from a rent in the middle meningeal artery found its way through the fracture, outside the skull, beneath the scalp. It is stated in the second case, with reference to the meningeal clot, that "the oozing had no doubt been gradual," and it is probable that such was the case in Mr. Swain's, there being no stertor, the pupils reacting to light, the patient moaning though unconscious, and the coma increasing gradually up to the third day.

η. Limbs rigid, convulsed, or twitching.—Owing to the length to which this article has already run on, the writer will do little more than point out the fact that because, instead of hemiplegia, the limbs are found in one of the above conditions, it must not be concluded that there is no meningeal extravasation and compression.

Rigidity is very rarely mentioned as in Case 59, where it is said to have occurred by itself; in Case 9 it was present, but combined with convulsive movements.

The late Dr. Todd believed that hemiplegia with rigidity of the paralysed muscles was not at all uncommon in middle meningeal hæmorrhage. Thus he writes,[1] "Indeed, when hemiplegia with a rigid state of the muscles supervenes soon upon some injury to the head, you may almost always make a certain diagnosis that it is the result of irritant compression by depressed bone or by hæmorrhage outside or inside of the dura mater."

If there be restlessness, spasmodic movements or twitchings of the limbs, it is only too probable that in addition to middle meningeal extravasation, contusion or laceration of the brain-substance will be found at more spots than one.

[1] 'Clin. Lect. on Paralysis, &c.,' p. 222.

c. *Condition of the Pupils.*

While this may be various, there are at least three conditions which are most important.

(*a*) If the pupils are natural as regards reacting to light, the compression of the brain is probably in a recoverable condition, if trephining is immediately performed. Furthermore, it is probably a case of compression only of the brain, without laceration or other injury.

(β) If the pupils are insensitive and often at the same time dilated, the compression is probably extreme, and while trephining is as urgently called for, it is less probable that in these cases the brain will recover itself after removal of the clot.[1]

(γ) If one pupil is found widely dilated, the other being natural or contracted in size, and if the dilatation be present on the side of the face corresponding to the part of the head injured, in other words opposite to the side paralysed (if hemiplegia be present), it is a sign of the greatest importance.

While this condition has been noticed by earlier writers, it is to Mr. Hutchinson that we owe the explanation and the demonstration of the importance of this most valuable symptom.

It is more than eighteen years ago since he first published his explanation of this condition of the pupils, in one of the Lectures[2] to which reference has been already made. "A week ago at a clinical lecture I had the opportunity of illustrating one cause of unilateral dilatation of pupil after injury to the head. A man had died in whom this symptom was present, in whom we found a large clot of blood pressing forward upon the sphenoidal fissure, and no doubt compressing the trunk of the third nerve. In our present case, singularly enough, the cause of this symptom proves to be the same. . . . . This fracture on the left side has crossed the trunk of the meningeal artery, and a large clot of blood is

[1] "In general, as the mischief is continued and augmented, the pupils become dilated and immovable." Guthrie, 'Injuries of the Head affecting the Brain,' p. 42.

[2] "On Compression of the Brain," 'Lond. Hosp. Rep.,' vol. iv, 1867, p. 29.

found between the dura mater and the bone, extending downwards into the sphenoidal fossa. I have not dissected it, wishing not to spoil the specimen, but from the position of the clot there can be little doubt that the third nerve is compressed, and thus the dilatation of the pupil is explained. These two cases go exactly parallel, and seem to supply us with a new and very valuable symptom, indicative of effusion of blood in this situation."

As we thus owe the explanation of one-sided dilated pupil and its value in middle meningeal hæmorrhage to Mr. Hutchinson, this symptom might be known for the future as "the Hutchinson pupil."

In drawing attention to the above fact the writer, though convinced of its value, would not wish to mislead by appearing to overrate it. In other words, one-sided dilatation of the pupil is, of course, present in other head injuries, *e. g.* in fractured base and injury to the third nerve,[1] and other lesions in which the explanation is useless. But it is when taken in conjunction with other evidence, *e. g.*, the interval of consciousness, hemiplegia, coma, stertor and slow pulse that this condition of the pupil will be of convincing value. It should be remembered also that, in such conjunction, it not only means middle meningeal extravasation, but a large clot, and if the case has been carefully watched, and this symptom has been absent at first, an extending clot. Finally, as Case 32, p. 214, shows, this condition of the pupil may come on suddenly, heralding, with brief interval, the onset of a fatal issue. Thus, in the above case a boy had been admitted on a Thursday with a bruised temple and fractured humerus. He remained conscious, restless, and without paralysis till the Friday, when about 3 p.m. Mr. Hutchinson found that "he could scarcely see with the right eye, and that his right pupil, which on the previous day had been of the same size as the other, was widely dilated and fixed. Insensibility came on soon after in the same evening, and the boy died about 8.30."

[1] An excellent instance of unilateral dilatation of the pupil due to laceration of the left third nerve, the posterior clinoid processes being fractured, will be found fully reported in Mr. Hutchinson's 'Clin. Surg.,' vol. i, p. 174.

D. *The Pulse.*

This will vary according as the case is one of well-marked, uncomplicated extravasation, or complicated with contusion or laceration of the brain, and, if the concussion stage has been severe, according to the degree to which the heart has recovered from this.

In cases of well-marked and uncomplicated compression the pulse will be slower than normal, and usually somewhat full and labouring. Thus in Case 28 it was 64 a quarter of an hour after the accident, and then quickly fell to 42, being now slow and laboured. In Case 36 it was very full and tense, 36 per minute. In Case 56 it was 42, rising to 128 before death. In Case 65 it was "52 and still falling;" in 66 "under 63 and laboured." In other cases the pulse is described as "slow and of moderate calibre," "84, soft and deliberate." In Case 34, which, in Mr. Hutchinson's words, "was one of the most simple and definite examples of death from compression which we could have," the pulse was very peculiar. Quoting from the same writer, "it was jerking and rapid and yet very firm. I think I scarcely ever felt an artery more resistant to pressure than it was, yet it had a frequency of 148 in the minute."

E. *State of Coma or Unconsciousness. Its mode of onset, &c.*

As is well known, coma may come on at once, as in Cases 22 and 23, after the fall or other injury, or after an interval of lucidity of uncertain length and distinctness.

The following points deserve, perhaps, to be particularly insisted upon with regard to the coma of middle meningeal hæmorrhage.

(*a*) The degree of unconsciousness will vary with the size of the branch injured, and the rapidity with which the blood is effused and the brain compressed. Where the effusion is rapid and the compression great the coma may be as deep and complete as in apoplexy with spontaneous cerebral hæmorrhage causing extensive damage. But in other cases where the extravasation is less it will be found that though the coma is apparently deep this is not really so; thus the patient may "moan constantly," or may "move arms and legs feebly when disturbed."

(β) The commencing coma may be taken for natural sleep, in which the patient may be allowed to lie till it is too late, as in Cases 2, 3, and 20, for the surgeon to do the slightest good. And several of the cases, *e. g.* 37, 38, 41, 45, show, what is more common, that the coma of middle meningeal hæmorrhage may be mistaken for drunkenness.

(γ) In a small number of cases the onset of the coma is deferred till late, as in Cases 32 and 33; its onset is here sudden, its course rapid, and it generally ends in death.

v. *Respiration.*

This is usually described as stertorous, and so it frequently is. Thus, in twenty-seven out of seventy cases stertorous breathing is distinctly mentioned. In other cases it is "loud." In two it is "laborious." In two the character is "snorting." In the writer's second case it was puffing rather than stertorous, this first epithet recalling the words of Mr. Guthrie, "The breath is sometimes emitted from the corner of the mouth like a whiff or puff of smoke, with something of a similar noise, which when permanent is a more dangerous symptom than the common snoring or stertorous breathing."[1] In three cases only is it stated that the breathing was "not stertorous;" in one "respiration was normal." In one, a boy æt. 10, it was moaning at times, at others stertorous. The breathing when stertorous is usually, but not necessarily, slow. Thus in Case 35 it was 30 per minute.

As is well known, stertorous breathing is met with in other cases of intracranial lesion than middle meningeal hæmorrhage (see p. 280). It will be of more importance to point out that in cases where stertor has not supervened to call attention to the existence of compression, other and still graver alterations in the breathing may be present, alterations which are warnings that the end is not far off, and that, in the case of intended trephining, there is no time to lose.

Thus, in Mr. Godlee's case, No. 17, insensibility having set in rapidly, "the respirations were catchy and short; he yawned at intervals and grew rapidly weaker. Chloroform

[1] 'Injuries of the Head affecting the Brain,' p. 42.

(for trephining) seemed to alter the already failing respiration so much for the worse that the operation was completed without an anæsthetic. Artificial respiration also was required; the pulse grew gradually weaker and the boy died."

In Mr. Beck's case, No. 27, two hours and forty minutes after the fatal fall the boy was somewhat cyanosed and breathed at long intervals, respiration seeming obstructed by mucus. Fifteen minutes later the "breathing had become much more infrequent, patient being once taken for dead and the sheet thrown over his face; however, he gave a gasp after an interval of quite half a minute, artificial respiration was immediately resorted to, and he came round."

In Mr. Beck's case, No. 28, at p. 200, about two hours after the young woman had fallen on her head, the breathing was "stertorous and irregular, occasionally ceasing for an interval of ten or fifteen seconds. In this respect she was getting rapidly worse."

Whether rapid or slow, whether stertorous or not, the breathing in these cases sometimes ceases suddenly. Thus, in Mr. Durham's case, No. 35, the patient having been insensible for several hours, "at 4 p.m. the face suddenly became livid and the respiration stopped, though the heart continued to beat for some time."

6. *State of the Scalp and of the Cranial Bones when sawn in trephining* (Abernethy).

The following conditions may be found to be present in the scalp after it has been shaved, and are of great value when the history is deficient or when the signs of compression are not well marked, viz. ecchymosis or contusion of the parietal and temporal regions giving rise to a puffy or pulpy feel.

This condition of the scalp will be especially marked when the hæmorrhage from the middle meningeal artery is finding its way through some fracture into the tissues of the scalp. A good instance of this is shown by a preparation in St. George's Hospital Museum, Ser. 1, No. 4, figured by Mr. Holmes in his 'Treatise on Surgery,' 4th ed., p. 140, fig. 39. It shows the parietal bone of a child, æt. 5, in which a gaping

fissure crosses the groove for the middle meningeal artery, producing considerable extravasation inside the skull and still more externally. The child was admitted a week after the accident with a large blood-swelling above the ear, but without any cerebral symptoms. The child died of meningitis eight days after admission. The fissure is unusually wide and gaping. The power of the brain to accommodate itself to intruded hæmorrhage has been alluded to once or twice in this paper. It is especially likely to be met with in children with their softer bones, more yielding sutures, and communications still persisting between the intra- and extra-cranial venous circulation.

The following extract from the writings of Abernethy shows not only that he recognised the difficulty of diagnosing these cases of middle meningeal hæmorrhage, but that he laid stress on a particular condition of the bones overlying the clot, viz. their bloodlessness, a condition which he believed to be due to the interference with its blood supply from the separation of the dura mater and its arteries. It will be interesting to note whether trephining in the future confirm the accuracy of Abernethy's belief.[1]

"It is of great importance to distinguish accurately the nature of such cases, and the distinction is not difficult when there is an interval of sense between the blow and the stupor occasioned by the effused blood. . . . But although we are assured that the patient labours under the effects of compression, cannot in many instances know the situation of the compressing cause. In other cases, again, where there is no interval of sense after the accident, we are at a loss to determine whether the senseless state be the effect of compression or of concussion. Every surgeon must acknowledge that it would be a very desirable thing to ascertain when blood is effused between the dura mater and the skull, for if the extravasation has happened in the more interior parts a surgical operation is not likely to afford relief.[2]

[1] 'Injuries of the Head,' loc. supra cit.

[2] In those cases, which I have seen, where blood was extravasated between the dura and pia mater, and a division of the former membrane was made for its discharge, in some instances the serous part of it only could be evacuated; for the coagulum was spread over the hemispheres of the brain, and had descended as low as possible towards its inferior part; in others, though a portion of the

"Now, if the extravasation which compresses the brain be situated immediately beneath the bone, I think there are signs by which it will be disclosed; and as sufficient notice has not been taken of these, I wish particularly to call the attention of surgeons to them. I have already said that unless one of the large arteries of the dura mater be wounded, the quantity of blood poured out will probably be inconsiderable, and the slight compression of the brain which this occasions may not be attended with any peculiar symptoms; or perhaps it may occasion some stupor, or excite an irritation disposing the adjacent parts to become inflamed; but both these effects will gradually abate, nor will any inflammation ensue, if proper means are taken to prevent it. It is indeed highly probable that, in many cases which have done well without an operation, such an extravasation has existed. But if there be so much blood on the dura mater as materially to derange the functions of the brain, the bone to a certain extent will no longer receive blood from within; and by the operation performed for its exposure the pericranium must have been separated from its outside. I believe that a bone so circumstanced will not be found to bleed, and I am at least certain it cannot with the same freedom and celerity as it does when the dura mater remains connected with it internally. I need hardly say that in the cases which I have related there was not the least hæmorrhage. But it is right to mention that I have also twice been able, by attending to the want of hæmorrhage from the outside of the cranium, to ascertain the extent to which the dura mater was detached within; and very frequently, when symptoms appeared to demand a perforation of the skull, I have seen it contraindicated by the hæmorrhage from the bone; and, as the event proved, rightly."[1]

effused blood was discharged in a fluid or grumous state, a considerable quantity which was coagulated remained behind, so that very little relief was obtained by the operation. It seems then that extravasation between the dura mater and the cranium is almost the only case which admits of being remedied by the use of the trephine.

[1] In aged persons and in those in whom the circulation has been rendered languid by the accident, the mode of distinction which I have pointed out may indeed be less conclusive.

Diagnosis of Middle Meningeal Hæmorrhage; some conditions with which it may be confused.

There are three surgical lesions which especially require mention here in addition to those more purely medical ones in which unconsciousness and paralysis, perhaps complicated with the history of a fall, may raise the question of middle meningeal hæmorrhage. Owing to the length to which this paper has already extended these latter conditions will only be here just alluded to; the three former lesions deserve rather fuller mention in a surgical paper, and are:

(i) Contusion or laceration of the brain-substance, especially of the temporo-sphenoidal and frontal lobes, the ecchymosis and consequent softening and disorganisation extending inwards to the corpus striatum.

(ii) Laceration of the lateral or superior longitudinal sinus, and extravasation of blood between bone and dura mater or into arachnoid cavity.

(iii) Hæmorrhage, after injury, into the arachnoid cavity.

(i) *Contusion or Laceration of the Brain-substance simulating the symptoms of Middle Meningeal Hæmorrhage.*

Perhaps no better proof of how impossible it is to make a certain diagnosis in some instances between these two conditions, laceration of the brain and middle meningeal hæmorrhage, can be given than by pointing out that in the following case Mr. Hutchinson, while diagnosing fractured base and contusion of brain, advised that trephining should be immediately performed, because it was impossible to be certain that there was not a large middle meningeal extravasation.

Case 72.[1] *Fall of ten feet upon the head; total insensibility from the very first; stertorous breathing; full, large pulse, with remarkable variations in rate and power; left extremities believed to be more completely powerless than the right ones; death in six hours; smash of anterior lobe of right hemisphere;*

[1] 'Lond. Hosp. Rep.,' iv, p. 17.

lengthwise fracture through foramen magnum ; more than an ounce of blood in arachnoid cavity.—J. T—, æt. 25, was admitted at 5.30 November 25th, having fallen ten feet, pitching on his head. He was totally insensible from the very first. There was a slight scalp wound over the occiput. A little blood flowed from the left nostril, but none from either ear. No fracture could be discovered. His right pupil was twice as large as the left, and both were quite fixed. Loud stertor. No deviation of face. Both conjunctivæ quite insensible. On lifting the left arm it fell quite helplessly, while there was slight resistance on the part of the right arm. The pulse varied much at exceedingly short intervals, being 60, 80, 108, within a few minutes. It was large, jerky, and full. Five hours after admission he was seen by Mr. Hutchinson, who "gave a diagnosis of fracture of base of skull and contusion of brain, but advised that trephining should be immediately performed, because it was impossible to be certain that he had not large extravasation of blood external to the dura mater. He was evidently about to die. The absolute insensibility, the stertorous breathing, and the full pulse were all symptoms which are usually referred to compression, and therefore I judged it right to give him the chance afforded by an operation.

"Mr. Colman, the house surgeon, at once commenced the operation, selecting the right front temporal region. He had only divided the scalp, however, when the pulse became very rapid and then ceased altogether. Respiration ceased simultaneously, with the exception of a few feeble sighs during the next five minutes. I do not think that the incisions into the scalp had anything to do with what followed them, for several times during the quarter of an hour that we had stood by the man's bedside we had quite thought that he was dying."

Post-mortem examination.—There was a scalp wound on the occiput a little to the left of the middle line, and for a considerable distance in this region the tissues of the scalp were ecchymosed. The anterior lobe of the right hemisphere was most severely and extensively contused. The contusion involved its under surface and the whole of its anterior and outer aspects, extending deeply almost to the corpus striatum. The cavity of the arachnoid contained soft, dark coagula, probably not less than an ounce. A line of fracture was

found to extend upwards and backwards from the foramen magnum through the occipital bone, ending as a mere crack in the lower and posterior angle of the left parietal bone. It also implicated, on the left side, the jugular foramen and tip of the petrous bone, ending as a very narrow crack in the body of the sphenoid and left cribriform plate of the ethmoid.

Case 73.[1] *Fall in the street; vomiting of blood; hemiplegia and imperfect consciousness; great restlessness; death on tenth day; fracture of base; extensive laceration of left sphenoidal lobe with red softening extending inwards towards the corpus striatum.*—E. F—, æt. 71, was seen by Mr. Hutchinson at the London Hospital November 6th. She had been brought to the hospital in the previous evening, it being a question whether she had been knocked down or fallen in a fit. She could use her left hand pretty freely, draw up the bedclothes, &c., and resisted forcibly when it was held. Her right upper extremity she rarely moved, and she appeared to have little or no power in the hand. The left lower extremity she moved well, resisting at once when the foot was tickled. The right she could move a little, but with much less power. Her right foot was severely contused. When admitted she was pale and insensible, but was roused sufficiently to tell her name on two occasions. Soon after admission she vomited several times, and on the first occasion brought up a considerable quantity of blood. There was no bruise found on the head. The patient lived several days, restless, gaining a little consciousness, the right limbs remaining almost completely paralysed, and death taking place with increasing weakness, and difficulty of breathing.

Post-mortem examination.—The only bruise on any part of the skull was a small one just above the right temporal ridge about an inch and a half from the vertex. There was a little blood between the dura mater and the right squamous bone, and a fracture was found at this spot. It crossed the squamous part of the temporal bone horizontally, near its middle, and gained the temporo-parietal suture, which was loosened. The temporo-occipital suture was also loosened. Anteriorly the fissure in the squamous portion extended

[1] Mr. Hutchinson, 'Clin. Surg.,' vol. ii, p. 46.

downwards and forwards, and was lost in the great wing of the sphenoid. Very probably a fissure extended into some part of this bone (pterygoid processes) adjacent to the pharynx, thus explaining the bloody vomit. The portion of the posterior lobe in contact with the separated suture showed a patch of ecchymosis into its structure as large as a hazel nut, and around this patch numerous minute dots of extravasation. On the side opposite to the fracture there was very extensive contusion of the sphenoidal lobe and of the side of the hemisphere immediately adjacent to it. Beneath the sphenoidal lobe there was a soft, dark blood-clot, and blood was besmeared over all parts of the arachnoid sac. The middle of the outer part of the hemisphere presented an excellent specimen of acute red softening; it consisted of a pulpy brown mass in which clots of blood were seen. The brain-substance surrounding this patch was dotted with ecchymoses, and around these the tissue was stained of a bright pine-apple yellow by the infiltration of blood-colouring matter. No lacerations of brain-structure were discovered at other parts, nor any extravasations. The lungs were much congested, especially at their posterior lobes, and showed large patches of grey hepatisation. At these parts the lung tissue was quite rotten and full of serum.

Case 74.[1] *Severe blow on occiput; complete insensibility; symptoms of compression closely simulated; death; severe contusion of under surface of right sphenoidal lobe, and hæmorrhage into optic thalamus.*—W. C—, æt. 50, was admitted into the London Hospital August 13th, having been struck on the occiput by the handle of a crane, which threw him forwards with great violence into a barge. When admitted he was quite insensible; his cheeks puffed to and fro in breathing. From the commencement he passed his urine and fæces unconsciously. The report is that his left lower extremity has never been moved since his admission.

August 15th.—He was much in the state above described. He was quite unconscious, lying on his back breathing deeply, but without stertor. His pupils were closely contracted. He never moved his left limbs. The question as to the propriety

[1] Mr. Hutchinson, 'Clin. Surg.,' loc. supr. cit.

of trephining was earnestly discussed. The completeness of the insensibility, although the circulation had fully rallied, seemed to indicate the probability that compression existed. The fact that the left limbs and side and face were paralysed, as shown by the absence of all reflex movements on irritation, indicated the probability that the source of compression was on the opposite side, and this fitted with the fact that he had been struck on the right. On the other hand, the facts that he had no stertor in breathing, and that his left side of face and left limbs still possessed sensation and reflex motion, were against the hypothesis of diffused and general compression, and indicated rather the existence of a local lesion. The operation was not performed. No marked change took place up to the time of the patient's death on the 16th, or three days after the injury.

Post-mortem examination.—At the base of the brain on both sides were numerous spots of ecchymosis, most of them small. There was a group about as large as shots beneath the sphenoidal lobe on the left side. On the right side the outer part of the anterior lobe and of the middle lobe was completely broken up by contusion. At this part there was a considerable mass, perhaps an ounce of coagulum in the arachnoid cavity. These lobes were also much contused on their under surfaces. The brain-structure was disorganised from the surface inward to near the corpus striatum. There was a considerable isolated clot of blood in the right thalamus. There was a limited patch of contusion on the outer side of the right hemisphere, just opposite to the fracture in the skull. In the left parietal bone was a fracture which passed obliquely downwards and forwards through the squamous plate and greater wing of the sphenoid.

Case 75.[1] *Fall from a cart; left hemiplegia; suspected rupture of middle meningeal artery; trephining; no blood found; death; laceration of brain and blood in arachnoid sac.*—"In October, 1867, I shared with Mr. Maunder the responsibility of advising an operation in a very interesting case, in which, however, no good was done. Yet I hold that the recommendation was justified by the symptoms. A man, who had fallen

[1] Mr. Hutchinson, 'Lond. Hosp. Rep.,' vol. iv, p. 49.

from a hay-cart, was brought into the hospital with a cut on the occiput and an irregularity in the bone near it, and with a bruise on the right side of the head. He was sufficiently conscious to tell his name and put his tongue out. Very soon after his admission he became quite unconscious, and when Mr. Maunder and I saw him, three or four hours later, he lay on his back so insensible that no amount of irritation would rouse him. His left limbs were paralysed, that is, they did not move when pricked, whilst his right ones always did so. The leg appeared to be less completely paralysed than the arm. There was no perceptible deviation of the face, but his left cheek occasionally puffed and his left cornea might be touched without any winking being excited. He had no stertor and his face was pale. He had been bled before I saw him, and his pulse had increased after it and was now rapid and rather feeble. He was clearly getting rapidly worse and about to die if nothing were done. A large extravasation of blood over the right temporal region prevented us from examining the bone and also led us to suspect a fracture beneath it.

"I strongly recommended immediate trephining, and for the following reasons: the man was said to have been partially conscious at first, and his insensibility as also the hemiplegia were stated to have much increased since his admission. The hemiplegia was on the side opposite to the injury, whilst on the side of the injury the pupil was widely dilated and fixed. This latter symptom had come on subsequent to admission, and it is one which I have several times met with in cases of large extravasation into the sphenoidal fossa from rupture of the meningeal artery.

"Mr. Maunder performed the operation, but no fracture was found nor any blood between the bone and dura mater. The man died in the course of the next night.

"*Post-mortem examination.*—There was a rather extensive fracture in the occipital bone and posterior part of the parietal. The chief lesion, however, was a laceration of the outer side of the right hemisphere near its middle with much extravasation into the arachnoid. There was probably an ounce and a half of blood-clot in the lacerated part and in the meshes of the pia mater. . . . To explain the hemiplegia which was

present in this case we must refer to the laceration of the convolutions in the middle of the hemisphere, and to the effusion of sufficient blood to cause a certain degree of compression. Let us note precisely that sensation as well as motion, and the face as well as the limbs, were involved and that the paralysis of the fifth seemed to exceed that of the facial.

"The point which rendered the recommendation of the operation less confident than it otherwise would have been was the imperfect history of consciousness soon after the accident. Everyone who had seen him agreed that he had got much worse, but observers differed as to the amount of consciousness which he had displayed, and at best it had been but little. It is certain that the value of the lucid interval before coma as a symptom of ruptured middle meningeal artery can scarcely be over-rated. It is worth all the rest together."

No better proof of the exceeding difficulty which may be met with in certain cases in diagnosing between middle meningeal hæmorrhage and laceration of brain could be given than by the above four cases, in three of which Mr. Hutchinson discussed the advisability of trephining, and in two recommended this step.

The following points may perhaps aid in making a diagnosis, though after what has just been said it is clear that there are none of certain reliability. 1. *The site of the head injury.*—In middle meningeal hæmorrhage any scalp wound or bruise is usually over the area of the artery. 2. *Interval of lucidity.*—It has been shown earlier in this article that while the violence which leads to middle meningeal hæmorrhage is very various it is often very slight. An injury which causes brain laceration will probably always be severe, and, there being no rallying from concussion before graver symptoms set in, the interval of lucidity is likely to be absent or very little marked. 3. *Convulsive twitchings.*—These are so often present in cases of laceration of the brain that though the conjunction is not invariable, and though similar spasms and twitchings are present in irritation of the brain, whether by depressed bone or by inflammation of the membranes, their existence will go against middle meningeal hæmorrhage.

(ii) *Laceration of the Lateral or Superior Longitudinal Sinus, and Extravasation of Blood between Bone and Dura Mater or into Arachnoid Cavity.*

Case 76. *Fracture of occipital and right temporal bones; rupture of right lateral sinus; extravasation between bone and dura mater; paralysis of left side; death on fourth day.*—J. W—, admitted under Mr. Durham, February 13th, 1875, having fallen from a house. There was a contused wound at the back of the head, an incised one in front. Patient very irritable, pulse 74, no stertor in breathing; no bleeding from ears; sphincters relaxed; two hours later, pulse 50; slight bleeding from nose; mouth drawn to left side. February 14th.—Sick during the night; restless and irritable; has some bronchitis. 15th.—Pulse 88, temp. 103°; lies on left side, it is difficult to rouse him, and when roused he is only partially, if at all, sensible; eyes closed, pupils equal, but sluggish; right facial paralysis continues; evening temp. 101·6°; resp. 26, pulse 85. 16th.—Still lies in same unconscious state, and in the same position; right facial paralysis continues marked; both pupils act, but the right is the larger; sphincters still relaxed. 17th.—Has had several fits during the night; face pale; no movement of left arm or leg, moves those on right side freely. The left, when raised, fall as though paralysed. Several more fits occurred during the day, at first in rapid succession, and then constantly after 4 p.m. up to the time of death, which took place at midnight.

Post-mortem examination.—There was a fissure in the right cerebellar fossa of the occipital bone, extending downwards into the lateral sinus, and still further forwards between the occipital and temporal bones. There was a quantity of black clot between the bone and dura mater in this position. The two anterior lobes of the brain were extensively and deeply bruised as was also the apex of the left middle lobe. There were masses of black clot as large as nuts in the cerebral substance, together with some punctiform ecchymoses, and round the affected parts yellow softening.

Case 77.[1] *Depressed fracture of lower and posterior part of left parietal bone; laceration of lateral sinus, free hæmorrhage;*

[1] Mr. Erichsen, loc. supr. cit.

elevation of bone, and arrest of hæmorrhage by plugging; unconsciousness, and weakness of right side; hæmorrhage recurrent up to the tenth day; death from pyæmia on the thirty-first day. —W. P., æt. about 32, was admitted into University College Hospital on August 16th, having received a severe blow on the left side of the head from some bars of iron projecting beyond a railway truck. On admission he was unconscious, but struggled when the wound was examined. The wound was about two inches in length and irregular in shape, and situated about two and a half inches above the left mastoid process. On examination with the finger a large piece of bone could be felt to be deeply depressed, the upper part being depressed below the lower. A small loose fragment could be seen. This was removed with forceps, and sufficient room was so obtained to insert an elevator beneath the depressed fragment. The moment it was raised, a stream of blood, about as thick as the top of a finger, and rising to the height of about three quarters of an inch, poured out of the wound. The depressed fragment was immediately seized and pulled out. It was about two and a half inches in length by one and a half in breadth; it included the lower and posterior part of the parietal bone, but the groove for the lateral sinus was not included. It was now seen that the blood came from under the lower margin of sound bone, and in order to arrest it plugs of lint had to be pushed in between the dura mater and the bone. From the situation of the fracture with relation to the lateral sinus, it was evident that the depressed fragment had been driven downwards and inwards, and its point had lacerated the sinus, but was partially plugging the wound it had made. On raising the fragment the blood burst out through the wound. The plugs of lint inserted in order to stop the bleeding lay in the sinus in the same position as the depressed fragment, and instead of pressing together the two sides of the sinus, they propped the wound open, and projected actually into the cavity of the sinus, a condition almost absolutely certain to cause decomposition and breaking down of any clot that might form, and so give rise to septic embola and pyæmia.

If the surgeon could possibly have fully comprehended the situation, the proper line of practice would probably have been to cut away the bone with a trephine or Hey's saw till the

sinus was brought fully into view, and then to apply direct pressure. This operation might have been easily performed while the plugs were arresting the hæmorrhage. But such minute diagnosis is impossible. On the fourth day the temp. rose to 102° and he had a rigor. On the fifth day the plugs were removed, but the blood poured out just as at first. The plugs were immediately reapplied on the same day; convulsions commenced. They began by twitching of the right side of the face, and turning of the head to the right side; then the right arm twitched, then the right leg, then the left leg, and finally the left arm. At this time there was some evident want of power in the right side, but this disappeared in a few days. He had become more conscious and seemed to know his name when spoken to. On the sixth day he had twenty-seven convulsions. Temp. rose to 104·5°, and he had another rigor. The convulsions continued till the eleventh day, when they ceased. He had then gained consciousness to a great extent, knew his wife, and could answer questions. On the tenth day another attempt was made remove the plugs, and the greater part was got away, but on trying to remove the deeper part hæmorrhage again commenced, but ceased at once on applying a new pad over the remnant of the old one. On the fifteenth day the plugs were successfully removed, but the symptoms of pyæmia were now well marked, and the patient ultimately died of this disease on the thirty-first day. A few days before death, a large abscess formed in the neck below the mastoid process; on squeezing this, pus could be made to pour out from the hole in the skull.

Post-mortem examination. — The sinus was not firmly occluded, being filled on each side by soft, decolorized, putrid clots. This condition of thrombosis, and the composition of the thrombus, had extended into the mastoid vein and through the mastoid foramen, and it was this that had caused the abscess in the neck, on squeezing which the pus found its way by the mastoid foramen into the lateral sinus, and from that through the opening in it into the wound in the head from which it flowed. The rest of the post-mortem was characteristic of the pure, embolic form of pyæmia.

(iii) *Hæmorrhage into the Arachnoid Cavity.*

Case 78.[1] *Fall on to head off a brewer's dray; symptoms of concussion, followed after some hours by those of compression; hæmorrhage into cavity of arachnoid; much contusion of brain; no fracture; death about twenty-two hours after the injury.*—H. B—, æt. 33, a brewer's drayman, was admitted into the Westminster Hospital, under the care of Mr. Holthouse, at 8 p.m., April 4th, 1861. He had walked all the way from Victoria Street, supported, however, by two of his comrades. He had been riding at the end of his dray, in the afternoon, when he fell off. The dray being stopped he was lifted on, being stunned and insensible. On reaching the brewery he had so far recovered from the stunning effects of the fall that he went about his usual work of lifting barrels in and out of the drays, being observed by his comrades to look pale, though he would not confess to being ill. Having finished his work about 7.30 p.m., he became insensible and no longer able to answer questions. Two of his comrades therefore led him to the hospital, where he arrived at 8 p.m., looking and walking like a drunken man. He did not, however, smell of liquor, and it was stated that he had taken nothing since the accident. He was unable or unwilling to answer any questions, but put out his tongue when told to do so. His pupils were contracted, his pulse 78. No external injury could be detected, and there was no bleeding from nose, ears, &c. An enema of turpentine was administered, shortly after which he got out of bed without assistance, saying to the nurse, "Leave me alone." These were the only words he uttered while in the hospital.

The patient was seen by Mr. Holthouse at 10 a.m. next day. He was then lying on his back, his eyes closed, his face flushed and congested, perspiration profuse, respirations normal in frequency but soufflant; pulse 72, natural; pupils neither contracted nor dilated, and not acting on the admission of light. On tickling the soles of his feet, vigorous reflex movements took place, especially of the right foot, but on raising the arms and legs they fell of their own weight. The patient could not be roused by shouting to him, or by shaking him, and both motions and urine were passed under him.

[1] 'Lancet,' 1861, ii, p. 373.

2.30 p.m.—He started up suddenly in bed, as if about to jump out of it, became black in the face, and his right arm and hand were firmly flexed and convulsed. This lasted for a few seconds only, and the house surgeon, who was sent for, found that he was lying in the same quiet condition as before. He died calmly about a quarter of an hour afterwards, and about twenty-two hours after the accident.

Post-mortem examination.—Slight subcutaneous ecchymosis in each temporal region—most in the right; dura mater shining, distended, and purple from blood visible beneath it, over the whole of the left hemisphere and the posterior half of the right. On cutting through this membrane, a large quantity of semi-coagulated dark blood occupied the cavity of the arachnoid over those parts of the hemispheres where it had been seen through the dura mater. The under surface of the anterior lobe, and the adjoining part of the middle lobe on the left side, were found to be broken down, as if ploughed up by blood, which here existed in great quantity.

A similar condition of the brain-substance was met with in the centre of the middle lobe of this side just external to the corpus striatum, and surrounding which there was also much bruising. There was a good deal of blood in the sulci between the convolutions of the left hemisphere, and in the anterior and middle fossa of the base of the skull, but the right hemisphere was uninjured, and no blood was extravasated between its convolutions. The most careful examination failed to detect any fracture.

Looking at the general distribution of the effused blood, it would appear to have first escaped from the vessels of the brain at the parts torn, and then to have forced its way into the subarachnoid spaces, and into the cavity of that membrane, spreading first over the left hemisphere from before backwards, and then over the posterior part of the right from behind forwards.

Case 79.[1] *Depressed fracture of parietal bone; compression symptoms; trephining; hæmorrhage into arachnoid cavity; incision of dura mater; immediate relief of symptoms; recovery.*—A young labourer in a coalmine was struck by an iron chain,

[1] Guthrie, 'Injuries of the Head,' p. 153.

which had fallen on him from a height of nearly 200 feet. There was no external wound, but considerable tumefaction of the scalp; and as, some hours afterwards, he was labouring under symptoms of compression of the brain, it was deemed advisable to divide the scalp to ascertain the state of parts beneath. The left parietal bone was found to be most extensively fractured at its most protuberant part; two fissures, extending nearly the length of the bone, joined by two others, enclosed an irregularly shaped portion of bone, the inferior angle of this piece being considerably depressed. On applying the crown of a trephine to raise the depression it was discovered that the internal table was so much more extensively fractured than the external that it required twelve applications of the instrument before the broken edge of the internal table could be got at or its extent ascertained. The dura mater when exposed was found distended by a quantity of blood extravasated underneath it. No abatement of the symptoms being perceived to follow the elevation of the bone, it was decided to endeavour to evacuate the blood by an incision through the membrane. This was accordingly made by a short lancet, to the extent of about three quarters of an inch. Some blood flowed out, the symptoms of compression were immediately relieved and shortly disappeared. The edges of the scalp were brought together over the wound, lightly retained *in situ*, and the wound covered with lint. Nothing unfavorable afterwards occurred and the man got quite well.

Case 80.[1] *Fall in the street; symptoms of compression; question of trephining; death eight hours after the injury; large clot in arachnoid cavity over injured side weighing five ounces, a thin clot over opposite hemisphere; numerous small ecchymoses in various parts of brain.*—"On the afternoon of November 29th, 1862, I was asked by our house surgeon to see a man who had just been admitted in a state of insensibility. The history was that he appeared at 10 a.m. with a lacerated wound of the scalp, which was dressed and he was allowed to leave. He had now been brought again by the police, who had

[1] Mr. Hutchinson, 'Lond. Hosp. Rep.,' vol. iv, p. 22.

found him insensible in the street. He was a robust sailor, of about 35. I found him perfectly unconscious, breathing stertorously, with a suffused countenance, and slow (72), laboured pulse. Neither pupil acted in the least; the left was rather the larger, but neither of them was much dilated; the eyes diverged a little; there was a considerable bruise in the left eyelids, and on the occiput of the same side a considerable laceration of the scalp. The left temporal region was somewhat swollen; no blood had escaped from either ear; no fracture or fissure of bone could be detected. The man was quite unconscious, and by no amount of irritation could I induce the slightest muscular movement. The nurse and porter told me that he had not moved in the least while being lifted to the bed. His respiration was tolerably good and quite regular, but attended by constant and well-marked stertor. The skin of his left hand was warm, rather hot; that of his right decidedly cold; both feet were rather cold, and I could not detect any great difference between them. As regards the difference of the temperature between the two hands it was most marked, and unmistakeably one hand felt positively hot, the other positively cold. His face was not drawn to either side, both cheeks puffed slightly in expiration. It will be seen, therefore, that the only one-sided symptoms which we could discover were the divergence of the left eye, the dilatation of the left pupil, and the increased heat of the left upper extremity. We could get no information as to how long he had been insensible; the policeman believed him drunk, but we could detect no odour of spirit. No information was obtainable as to the exact manner in which he had received his injuries, but the dresser who had attended him in the morning told me that he appeared at the time rather stupid though quite able to answer questions, and that he then stated that his head had been cut in a fall in a fit; whether he was liable to fits or not had not been ascertained. In the morning he walked away from the hospital, a policeman being with him, who promised to see him home; he was believed to have been up all night drinking. I could not for a moment entertain the idea that his symptoms were due to intoxication. Although the history was very imperfect yet it seemed to coincide with the symptoms pointing to compression in the left side. My

conjecture was that the left middle meningeal artery was probably lacerated. I gave directions that he should be undressed and have his head shaved, and that I would return in an hour and trephine him. There did not appear to be any reason to expect a sudden termination, and as a certain amount of doubt attached to the diagnosis I preferred to wait a while before exposing his dura mater.

"On my return, at half-past six, I found that the man had died. He remained much as he was when I saw him for three quarters of an hour, then constant hiccough came on, and he rapidly sank. I regretted extremely that I had not given him the chance of trephining immediately on his admission, though, as his symptoms did not denote great urgency, I could not blame myself for not having done so.

"On the following day, in the post-mortem theatre, I performed the operation which I had intended to do had he lived till my second visit, *i. e.* trephining over the left arteria meningea media. The skull was exceedingly thick and dense, the dura mater was found adherent to the bone, and there was no blood between them. On cutting through the dura mater, however, a thick clot was exposed. The calvaria was now removed; over the left hemisphere was a thick clot by which the brain-substance had been greatly compressed; this clot weighed 5 oz., and left the parietal arachnoid much stained by adherent blood, which had to be sponged away. The clot extended downwards to the base of the brain, and a thin adherent film covered almost the whole of the opposite hemisphere, occupying the arachnoid cavity. There was no fissure of the bone anywhere, nor could any laceration of the arteria meningea media be discovered. The blood on the right side communicated with that on the left under the falx cerebri. An opening was found into the left lateral sinus at about the middle of its highest part; it was of small size and contained a clot. On slicing the brain blood was found extravasated in small spots of ecchymosis in numerous parts; on the surface of the lateral ventricles in several places were ecchymosed patches. In the middle of the pons Varolii were four or five well-circumscribed blood-clots from the size of a pea downwards to a pin's head. . . . The substance of the brain generally was firm, but close to the ecchymosis it was a little

broken down; there was nothing to amount to laceration in any part; the calvaria was in all parts extremely thick.

"It seemed probable that in this case the great strength of the calvaria had permitted the reception of a very severe blow or fall without fracture, and that in consequence blood-vessels had been ruptured at various places and the lateral sinus had given way.

"The symptoms of increased heat in one arm was of some value, in the almost complete absence of other indications by which to judge, as to which side was injured. No doubt had there been opportunity to have watched the development of symptoms, we should have noticed hemiplegia before unconsciousness, but when admitted the man was so utterly unconscious that no difference could be made out in reference to the two sides."

Later on Mr. Hutchinson,[1] in speaking of the difficulty of diagnosis of compression of the brain, says, "The second group of cases—*those in which the blood is under the dura mater*—may, in rare instances, resemble in every feature those just described," viz. cases of effusion between bone and dura mater. "If a large superficial vessel have been injured, it is possible that an interval may occur, and then a large clot be poured out. More usually, however, these cases are complicated by laceration of the brain, and the symptoms of severe concussion are present from the first. The bleeding usually takes place, not from one large vessel, but from many small ones, and hence it is poured out with much less of compressive force, and ceases much short of the results which a ruptured meningeal artery can produce. The patient may therefore live much longer, remaining throughout insensible, and with the stertor, laboured pulse, and flushed face formerly held to be universal in compression. The marked inequality in size of pupils, which we have noted in the subcranial cases, will rarely be present, nor will hemiplegia usually be marked?"

Dr. S. W. Gross, discussing the various causes of compression of the brain,[1] writes of this one:—"Extravasation into the *arachnoid sac* co-exists with nearly all of the severe contusions of the cortex of the brain, when it is due to laceration of the

[1] Loc. supr. cit., p. 53.

[2] 'Amer. Journ. Med. Sci.,' N.S., vol. 66, p. 49.

vessels of the pia mater, with simultaneous rent of the visceral arachnoid. It is also occasioned by rupture of the cerebral veins or of the great sinuses, or it may depend upon wound of the dura mater, and coexist with effusion on that membrane. . . . . The symptoms of this accident vary in intensity. In some cases there is no evidence whatever of cerebral disturbance, and even when the effusion is very considerable, provided it be diffused or spread over both hemispheres, the phenomena are vague and masked by those of laceration and contusion of the brain. . . . . When, on the other hand, the fluid is more circumscribed, or the compression is limited to one hemisphere, the symptoms are decided, but they are identical with those produced by effusion between the bone and dura mater from injury to the middle meningeal artery. In both conditions there are more or less marked coma, dilated pupils, slow, full, and laboured pulse, hemiplegia with diminution of the temperature of the opposite limbs, and slow, noisy, or stertorous respiration. In the majority of instances, after the immediate symptoms of shock have passed off, there is a lucid interval before unconsciousness sets in; whilst in others absolute insensibility exists from the very outset. In these latter cases the symptoms point to some extensive laceration or contusion of the brain itself; and I believe I am right in asserting that in them the pulse is rapid, small, or feeble, rather than slow, full, or laboured, whilst the breathing is at most noisy and unaccompanied by stertor. The differential diagnosis of subcranial and intra-arachnoid extravasation is, so far as I am aware, impossible, but an analysis of recorded cases leads me to confirm the observation of Mr. Hutchinson that the marked irregularity of the pupils is rarely present in the latter, and that the hemiplegia is not so decided."

While the diagnosis between these two extravasations must remain for the present very difficult, if not impossible, the treatment must be the same, viz. always to give the patient the chance offered by trephining. On removing a circle of bone the condition of the dura mater will very likely point to the presence of blood beneath it. It will probably bulge, devoid of all natural pulsation, and purplish in tint, into the trephine hole, and give to the fingers a feeling of fluid con-

tained within. It should be freely opened to relieve the tension within; the blood, if fluid, probably escaping rapidly in a stream, but if coagulated it will be even more difficult to get it away than in cases of middle meningeal extravasation, owing to its being confined in a serous sac, which reaches extensively upwards and downwards over the brain.

Treatment of Middle Meningeal Hæmorrhage.

The most important points in this may be summed up in the words—Trephine, and trephine early. If there be time the head should be shaved all over, for purposes of cleanliness, and for the better application of ice or freezing mixture in the case of continued hæmorrhage after removal of the clot.

If possible no anæsthetic should be given; if the patient be deeply unconscious or comatose none will be needed, and if there be threatening failure of respiration, an anæsthetic may be harmful, as pointed out by Mr. Godlee in his remarks upon his case at p. 186. Furthermore, if the operation be performed without anæsthetics it will be all the easier to detect changes in the patient's condition which are due to the operation.

The head being supported on a firm pillow or sandbag, the next step will be to expose freely the skull at the point decided upon for trephining. If there be a scalp wound, or if one parietal region be tumid or puffy, hemiplegia will probably be present on the side opposite to this, and it will be the wounded or puffy part of the scalp which the surgeon must explore. But this coexistence of hemiplegia of the side opposite to that injured is not always present. Thus in Dr. Watson's case at p. 169, after a fall in an epileptic fit, there was a bruise on the right side of the head, and the right side of the body was completely paralysed, the extravasation having here taken place on the side opposite to that struck, as found by the operator when he successfully trephined over the left side.

As a rule, therefore, the surgeon will explore the bone over the middle meningeal area on the side opposite to the hemiplegia. In the rare cases in which there is no hemiplegia the marked dilatation of one pupil may draw attention to the position of the clot, and the cases are very rare in which

neither this last symptom, nor hemiplegia, nor external bruising, nor the history of the case affords help.

When more or less complete paralysis is present instead of hemiplegia, as in Cases 19, 22, 36, 45, 52, the surgeon must be guided by any swelling on the scalp, by examination, if the paralysis is more complete on one side than the other, or even, if the symptoms of compression by meningeal extravasation are present, by exploring both sides, with a short interval if necessary. As shown above, p. 270, this general paralysis may be due either to bilateral extravasation or to a very large one-sided extravasation making pressure, through one hemisphere, upon the opposite one also.

Led by some such considerations as the above in his selection of one side for trephining, the surgeon proceeds to expose a portion of the middle meningeal area. The writer has already, p. 161, expressed his opinion that the site often given, viz. half an inch above the level of the external ang ular process, and an inch and a half above the process, is too low down on the skull-side. At the same time it was pointed out how rarely it is the trunk of the middle meningeal artery which is wounded, and how much more frequently it is a branch or branches which give rise to the hæmorrhage. In Case 30, where the writer applied the trephine an inch and a half behind and an inch above the level of the external frontal angle, the anterior and lower extremity of the clot was only just reached and further extensive enlargement of the wound upwards and outwards was required before the clot could be removed. In Mr. Beck's case, No. 27, on trephining at the site of the swelling in the left temporal fossa, "bone being taken away over the middle meningeal artery, the anterior edge of a clot was seen." In Mr. Howse's case, No. 9, p. 170, in which he trephined successfully, the left side of the scalp being found much swollen and a little blackened, the trephine was applied two inches above the ear, and, on removing the bone, "a black mass of blood-clot welled up at once."

In cases where there is no wound or scalp swelling, the writer is of opinion that the trephine should be applied at least one and a half inches above and behind the external angular process of the frontal bone unless the pupil on the side of the extravasation is widely dilated; in such cases,

as the clot has probably reached the base of the skull, p. 272, the trephine may be applied a little lower down, so as to expose the clot low down also.

In exposing the bone no incision is better than the old-fashioned crucial, into which any wound which exists should be converted. The scalp always bleeds very freely, and there is no simpler and quicker way of arresting hæmorrhage and at the same time retracting the flaps than by use of two or more of Sir Spencer Wells's forceps to the bleeding vessels. Extravasated blood in the scalp may be due not only to the scalp vessels, but to some vessel in the diploë as in Mr. Beck's case, p. 198, or to the bleeding from the meningeal artery coming through some fracture or fissure, p. 222.

The pericranium having been carefully reflected, the surface of the bone should be thoroughly examined for a fissure or starring line of fracture, and these are often extremely minute. Even if no fracture is found, the surgeon should always persist in the operation, as the fracture may not have been exposed, though present. In other cases it may only have implicated the internal table, or the artery may have been ruptured without any fracture whatever, pp. 156, 158.

In removing the bone a full-sized trephine should always be made use of, that the clot may be at once as freely exposed as possible.

On elevating and removing the disc of bone, the clot beneath may present itself with or without hæmorrhage going on actively. Warning of this coexisting hæmorrhage may be given by the pulsation of the clot, as in Mr. Symonds's case, No. 65, p. 248. The clot being removed by a small lithotomy scoop, one of Volkmann's spoons, or the handle of a small teaspoon, the hæmorrhage may cease or it may continue profusely, welling up from the point of laceration, which may be quite out of reach.

In a few cases, such as Mr. Erichsen's at p. 221, this hæmorrhage will quickly cease of itself. Mr. Erichsen, l. c., says: "Having removed the clot, what do you do with the middle meningeal artery? If it is torn, as in this case, you cannot stop the hæmorrhage, and there is no necessity to do so; you will find the hæmorrhage cease of itself." No less than six cases in this paper prove that this opinion, though backed by

the weight of Mr. Erichsen's standing, is given much too generally, and is therefore misleading. In Mr. Howse's case, No. 9, p. 171, after the removal of the bone "a black mass of blood-clot welled up at once, with considerable bleeding which did not yield to sponge pressure. It was then decided to suture the edges of the wound and apply digital pressure to the common carotid for three hours, and then, if needful, to tie the carotid; operation antiseptic throughout. Icebag with freezing mixture (three parts of salt and two of ice) applied over the usual dressings." In this case the pressure and the freezing mixture were sufficient.

In another case of Mr. Howse, No. 64, p. 247, "there was a great deal of hæmorrhage during the operation. . . . . About three hours after the bleeding was so great that another piece of bone had to be removed just below the first; several branches of the middle meningeal artery were tied, but as this failed to arrest the hæmorrhage, the external carotid was ligatured in the course of the evening and all bleeding then stopped."

In Mr. Symonds's case, No. 65, p. 248, "On elevating the disc of bone a pulsating clot was exposed and removed. The bleeding was profuse, and to reach the laceration a great deal of bone was removed by Hoffmann's forceps, two loose pieces of the sphenoid being found. Two lacerations were found in the vessel; one was closed by underrunning with fine gut, the other by completing the division of the vessel and twisting both ends. The bleeding, however, still continuing, and the bone having been incised to the base, the hæmorrhage was finally arrested by underrunning the artery with a piece of dura mater, and making traction on the ligature carried out of the wound, and by a pair of torsion forceps pushed down to the farthest accessible point and given a half twist."

In both of Mr. Beck's cases, 27 and 28, pp. 197, 200, the same profuse hæmorrhage was met with. In the former, after removal of a large clot lying on the dura mater, "violent hæmorrhage took place, but no distinct bleeding point could be discovered. During this time artificial respiration had to be resorted to at intervals, but as the brain filled up the place occupied by clot, the breathing became regular and the pulse rapid. The patient was now propped up in the sitting posi-

tion, and ice applied to the side of the face, neck, and head, the bleeding beginning to cease in great measure."

In Mr. Beck's second case, No. 28, removal of the clot "was followed by very profuse hæmorrhage, the source of which could not be seen or felt with the finger. The patient was immediately raised into the sitting posture and an icebag applied over the side of the head and face. In a short time the bleeding ceased, but the space from which the clot had been removed with the lithotomy scoop became rapidly filled again with coagulated blood."

In Mr. Swain's case, No. 21, p. 190, after removal of the depressed bone and the clot, "considerable hæmorrhage took place from the surface of the dura mater, and was only arrested by the use of the actual cautery."

The above cases show conclusively that the surgeon may, after saving his patient from the dangers of compression, have to face those of most serious hæmorrhage. To meet such a contingency the following steps appear to be indicated: (1) to try the effect of cold, as used by Mr. Howse and Mr. Beck, by the former as a freezing mixture applied over the usual antiseptic dressing, and by the latter on a rather more extensive scale, as a large icebag over the side of the face, head, and neck. It will be noticed that, in addition to the use of cold, Mr. Beck raised his patient into the sitting position, an additional aid, which will be all the more easily adopted if, as is advised above, p. 296, no anæsthetic has been given in these cases. Where the surgeon has trephined through a scalp wound with clean-cut edges of his own making, he may, in addition to the use of cold, further control the hæmorrhage by suturing the edges of the wound, as in Mr. Howse's case at p. 171, more particularly if he is able to see his patient at short intervals or leave him in competent hands; otherwise, if the hæmorrhage persist, this additional precaution may increase the risk of the compression which the operation has been intended to obviate. The use of cold failing, the cautery may perhaps be made use of successfully, as in Mr. Swain's case, p. 190, and especially if any oozing point is seen.

Again, if the bleeding point is found by the aid of a probe to lie in a distinct bony canal, the hæmorrhage may perhaps

be arrested by plugging this canal with a tiny wooden peg (*e. g.* the sharpened end of an ordinary match pared smooth), as suggested by Mr. T. Smith and used successfully by Mr. Willett and Mr. H. Marsh at St. Bartholomew's Hospital in cases of hæmorrhage from the descending palatine artery, after operations for cleft palate.

But the bleeding after removal of middle meningeal clot may be too persistent and profuse for these steps to be successful, and the surgeon will have to decide between (2) exposing the trunk of the middle meningeal low down and ligaturing it; or (3) by arresting the flow of blood through the common or external carotid. As exposing the trunk of the middle meningeal involves a second trephining, as underrunning the artery involves some risk of wounding the brain, and as, if the clot extends down as far as this point, finding the trunk may be a matter of difficulty and uncertainty, the writer would prefer to try the effects of compression, digitally, of the common carotid by deep pressure over the anterior tubercle of the transverse process of the sixth cervical vertebra. If this fail, as it very probably will in a patient "coming to" after an operation and as yet insensible of his danger and of the importance of submitting to treatment, an anæsthetic must be given and a ligature placed upon the external or common carotid. In selecting one of these vessels the surgeon will probably do well to follow Mr. Howse's example, and tie the external carotid, as in Case 64, p. 247. While there is no doubt that the free communication between the branches of the two external carotids tends to bring about a free and early establishment of the collateral circulation, yet this is more likely to lead to recurrent hæmorrhage in the case of such a branch as the facial than in that of the middle meningeal, and ligature of the external carotid trunk just below the digastric, the ligature being probably placed between the superior thyroid and lingual branches, though more difficult, is likely to be safer than ligature of the common carotid, inasmuch as it involves the patient in no additional special risks, such as those which result from interfering with the cerebral circulation.

While, however, the writer would recommend ligature of the external rather than of the common carotid, the following

case, recorded by Dr. Liddell,[1] shows that ligature of the common trunk may be followed by entirely successful results.

"*Shell fracture in left temporal region, which probably extended into basis of cranium; hæmorrhage from middle meningeal artery; deligation of left common carotid; recovery.*—W. C. A—, æt. 19, was wounded by a fragment of shell in the left temporal region, Dec. 28th, 1862, and treated in field and St. Louis hospitals.

"January 18th, 1863.—Hæmorrhage, amounting to twelve ounces, occurred from the middle meningeal artery, which, all other means failing, was arrested by tying the left common carotid artery, and did not recur.

"On May 28th, 1863, he was discharged from the service. In March, 1868, the Pension Examiner reported that he had dizziness and faintness on exertion or stooping, partial anæsthesia of the left side of his face, and that he was compelled to keep his room in the cold winters of Madison, Iowa, from liability to freeze of the left ear and side of face. He was known to be still in tolerable health in June, 1872, almost ten years after the casualty and operation."

Turning from the question of how best to treat hæmorrhage which persists after exposure and removal of middle meningeal hæmorrhage, two others present themselves: Is it advisable to trephine in those cases where it is probable or certain that the fracture of the side of the skull which has opened the middle meningeal artery extends down into the base also? The writer thinks that some of the above-recorded cases answer "Yes" decisively to this question, unless the fracture of the vault is so extensive, or unless such other lesions exist that the result is rendered quite hopeless.

Thus Mr. Hutchinson's case, No. 31, in which the evidence of meningeal compression passed off after a few hours, the man died on the ninth day, of the effects of erysipelas and pyæmia. An extensive fracture of the middle fossa of the skull was found, as well as the middle meningeal extravasation. With regard to the cause of death, Mr. Hutchinson did not think that "either the blood or fracture of the base had much

[1] 'American Journ. Med. Sci.,' vol. lxxxi, 1881, p. 344.

to do directly with the man's death. He died of erysipelas and pyæmia, and as regards either of the special lesions mentioned, it is quite possible that he might have recovered, and excepting the risk of fresh hæmorrhage, with sudden increase of compression, I do not think it would have caused danger in any way."

This disappearance of symptoms which have once set in and pointed to middle meningeal hæmorrhage is, of course, extremely rare.

In the writer's second case, No. 30, in which the patient was trephined and died of broncho-pneumonia on the seventh day, the base was also fractured through the middle fossa.

Again, in Mr. Cock's successful case it seems highly probable that the base of the skull was fractured, the man having pitched upon his head from a height of about seventeen feet.

Fractures through the base are usually, as is well known, simple linear fissures with neither displacement nor depression, and are chiefly dangerous through the violence which has caused them bringing about other intracranial lesions, &c., resulting in inflammation of brain or membranes.

The other question—Should the surgeon be satisfied with a single trephining and partial removal of the clot, or should he remove the skull and clot more extensively ?—has already been discussed at p. 173. For the present, and until a larger number of cases in which trephining has been performed for this hæmorrhage have been collected, that surgeon will probably be wiser who rests satisfied with a simple trephining in most cases, using a full-sized instrument and trusting to the "safety-valve"[1] action which this ensures for the brain.

Where, however, the operation has been somewhat delayed, and the clot, instead of being recent and soft, is firm, tough, and somewhat adherent, the writer would remove the bone freely, in order to remove such a clot more thoroughly, believing that such a course would be more likely to bring about re-expansion of the brain, which after all, and not only removal of the clot, is the object in trephining.

It is not for a moment forgotten that this freer removal of bone prolongs the operation and exposes diploë, but the anti-

[1] Mr. Beck, loc. supr. cit.

septic precautions which, nowadays, it is in the power of every surgeon to adopt, will very much diminish these risks.

And with regard to the above antiseptic precautions, while the writer is strongly of opinion that in hospital practice spray and other precautions cannot wisely be dispensed with, a surgeon called upon suddenly to trephine for middle meningeal hæmorrhage will find fairly efficient substitutes in iodoform, mercury bichloride, boracic acid, and eucalyptus dressings, if only he remember to provide for drainage, and bear in mind that the weaker the antiseptic and the fewer the precautions made use of, the greater the need of frequent renewal of the dressings.

With regard to the general treatment, and to such points as the very restricted diet, such drugs as calomel in adequate doses from time to time, and its action maintained by hyd. c. cret., perhaps in combination with pulv. Dover., no more than a passing allusion can be made here, but the writer would take this opportunity of expressing his belief that the use of small injections of morphia is, at the present day, still too much dreaded in head cases.

Prognosis.

The chief points on which this depends are whether the middle meningeal extravasation is probably complicated with such injuries as extensive fracture and brain injury, and secondly upon the date of the trephining, and whether, at this time, the brain recovers itself quickly or not. With regard to the former, or the existence of complications, the surgeon will, if asked to state the probable result, base his opinion on the history of the case, the severity of the violence, *e.g.* height of fall, whether any interval of lucidity has been present, and if so, for how long, and how well marked; how far the symptoms of compression, well-marked hemiplegia, the falling pulse, the stertorous breathing, &c., are present, or replaced by, or complicated with, those symptoms which are believed to point rather to laceration or contusion of the brain and its membranes, viz. restlessness, convulsive movements or

twitchings, pulse quick and sharp and other evidence of pyrexia, which show that inflammation of the brain has probably supervened upon the injury to its substance.

At the time of the operation the rapid rising up of the brain after relief to its compression, or the almost equally satisfactory evidence given by the immediate relief to or the gradual passing away of the symptoms of compression are well shown in some of the above cases. Thus in Case 14, after elevation of several fragments of bone and removal of a coagulum, "the brain which had been depressed regained its level immediately, and the man recovered his senses." So, too in Case 13, when Mr. Guthrie had removed a coagulum after musket-ball fracture, "the brain regained its level, the man opened his eyes, looked around, knew and thanked me. The pulse and breathing became regular; he said he only suffered a little pain in the part and should soon get well. He died, however, on the third day." Case 12, under the care of the same surgeon, Mr. Guthrie, "the brain did not, however, regain its level, and the man died."

Judging from the writings of some very eminent surgeons it would be thought that, whatever is done, middle meningeal extravasation is invariably fatal. Thus Mr. Hutchinson, in the remarks which close those "Lectures on Compression of the Brain" to which reference has already been often made, says[1] of *cases of effusion of blood between the bone and dura mater:* "These are especially important, because generally supposed to be capable of relief by treatment. Yet it is a remarkable fact that the modern annals of surgery do not, as far as I am aware, contain any cases in which life has been saved by trephining for this state of things. I suppose the fact is that death usually occurs too quickly and too suddenly to permit either of diagnosis or treatment."

Sir P. Hewett[2] writes almost as strongly: "In civil hospitals nearly all large extravasations of blood between the bone and dura mater co-exist with contusion and laceration of the brain-substance. The post-mortem records of St. George's Hospital show that within the last few years there have been twenty-five cases of large extravasations of blood between the bone

[1] 'Lond. Hosp. Reports,' vol. iv, p. 51.

[2] 'System of Surgery,' edited by Holmes and Hulke, vol. i, p. 576.

and dura mater, in all of which the brain was more or less extensively lacerated.

"Injuries of such a compound nature easily explain the difficulties as to the diagnosis, and the reason why the trephine is so seldom applied nowadays for extravasated blood; and why also, when resorted to, the operation so seldom succeeds."

The term used by Mr. Hutchinson, "modern annals of surgery," is a little indefinite, but if we restrict ourselves to the present century we find, in this paper alone, the following eight cases treated successfully by trephining or elevating:

1. Mr. Keate's case at St. George's Hospital in 1839, No. 5, p. 167.

2. Mr. Erichsen's at University College Hospital, No. 6, p. 167.

3. Mr. Adams's case at the London Hospital, Case 7, p. 168.

4. Dr. Watson's case on board a Crimean transport in 1856, Case 8, p. 168.

5. Mr. Howse's case at Guy's Hospital in 1884, Case 9, p. 170.

6. Mr. Cock's case at Guy's Hospital in 1841, Case 10, p. 174.

7. Mr. Guthrie's case at the battle of Salamanca in 1812, Case 14, p. 183.

8. Mr. Swain's case at the South Devon Hospital in 1885, Case 21, p. 190.

If we add to the above eight successful cases, one mentioned[1] by Sir P. Hewett as having been under Mr. Tatum's care at St. George's Hospital in 1842, and in which trephining was quite successful; two just mentioned by Mr. Guthrie as under his care after the sieges of Ciudad Rodrigo and Badajos,[2] both of which recovered, we have eleven successful cases, and if to these, by including the latter half of the last century in the "modern annals of surgery," we add the two successful cases of Mr. Hill, of Dumfries, treated by him in 1750 and 1751[3], Cases 18 and 19, pp. 186-7, the number of cases of middle

[1] 'System of Surgery,' vol. i, p. 576, loc. supr. cit.

[2] These sieges followed each other quickly in January and March, 1812.

[3] It must always be remembered that these cases were treated by trephining and most persevering care, and fully reported later on by one who was surrounded by all the difficulties which must have beset a "Gideon Gray," A.D. 1750.

meningeal hæmorrhage successfully treated is thirteen. This number is, however, but a poor record when it is remembered that this paper is based upon a collection of seventy cases.

If the writer has contributed in the very smallest degree to the elucidation of these cases, and their better detection in the future, the length of his paper will, perhaps, be the more readily excused.

The following conclusions are briefly appended:

1. That the violence which causes middle meningeal hæmorrhage is often slight.

2. That in these cases no fracture may be present.

3. That where there is a fracture it is often a mere fissure, and may involve the internal table only.

4. That in severer cases, laceration or contusion of the brain are only too frequently complicating.

5. That the history of the case, and above all an interval of lucidity or consciousness, are invaluable, the latter being worth all the other symptoms put together.

6. That the symptoms of compression are in some cases deferred, that their onset may be then very sudden and rapidly fatal, failure of breathing being a marked feature.

7. That in those cases where the history is deficient, especially as to any interval of lucidity, and where it is difficult to be certain about the existence of hemiplegia, dilatation of the pupil on one side, that side corresponding to the clot, is a sign of great value. The explanation of this sign, that the third nerve is being pressed upon by a clot large enough to reach into the middle fossa, we owe to Mr. Hutchinson, with whose name in future this condition of the pupil should be associated.

8. That after trephining, exposure and partial removal of the clot, very severe hæmorrhage may set in and prove very difficult to arrest.

In addition to the above the following conclusions of Mr. Hutchinson,[1] some of which have already been quoted under the head of diagnosis, may be repeated here:

"It would seem that it is not usual for a large hæmorrhage to occur at the time of the injury, for almost always there is an interval during which the patient is well before the sym-

[1] 'Clin. Surgery,' vol. ii, p. 64.

ptoms of compression come on. The occurrence of this interval is, as is well known, the most valuable fact in aid of diagnosis.

"It would seem probable that often hæmorrhage occurs in repeated attacks. The first may cause only temporary stupor and a slight degree of hemiplegia. These may pass off and then suddenly, after some hours or even days, a sudden accession of fresh symptoms may denote a fresh hæmorrhage, and may prove rapidly fatal.

"In cases where the bleeding is continuous, death may occur very rapidly. In these rapid cases the symptoms usually assigned to compression are absent, and failure of heart's action, with pallor, feeble respiration, and dilated pupils, are things which precede death.

"The occurrence or absence of hemiplegia is a very uncertain symptom. In the rapid cases it is never observed, because the patient rapidly becomes insensible, and in the more slow ones it is usually transitory, since the brain-mass accommodates itself to the local intrusion. In the early periods there is probably always some weakness of the opposite limbs, but if such a condition is marked and persists it is much more probable that there is laceration than compression by blood."

LIST OF SPECIMENS ADDED TO THE PATHOLOGICAL MUSEUM

DURING THE YEAR 1884-5.

By JAMES F. GOODHART, M.D.

The specimens added to the museum during the last year are ninety-one in number. This is hardly so many as in recent years, but the shelves are becoming crowded and it is year by year more necessary to be strict in selection. Indeed, in the future it will be imperative, as has already in some measure been the case, to replace old, rather than to add fresh preparations.

The first five preparations are the bones of a child under the care of Mr. Davies-Colley, which have undergone a remarkable rarification and in places are expanded into tumours. The case has been described by Mr. Davies-Colley in the 'Transactions of the Pathological Society,' vol. xxxv.

1007 is a specimen of spinal curvature, due apparently to a stooping occupation; it is, however, particularly interesting from the fact that the patient, a young man, also suffered from old pleuritic adhesions and a sacculated dilatation of the pulmonary artery, conditions which may either have helped to produce the curve or have been produced by it.

The nature of 1027 is also uncertain; by many it might be

called scrofulous or tubercular without question, but there are peculiarities about the disease which make the correctness of such an opinion doubtful.

1069[21 & 22] are from a well-marked case of osteitis deformans in a woman.

1325[50] shows to perfection the hypertrophy of the synovial fringes in osteo-arthritic inflammation of the knee-joint.

1400[30], a heart of a boy with rupture of the septum ventriculorum, is remarkable for the time the patient lived after the accident. Following this come a specimen of malignant endocarditis in a child, a case of tubercular pericarditis, a series of cases of dilated pulmonary artery, and several fine specimens of aneurysm; one of which (of the abdominal aorta) has undergone spontaneous cure.

1501[56 & 64] are examples of aneurysm of the cerebral arteries, 1504[47] a very remarkable aneurysm of the splenic artery ulcerating into the stomach, from a case of malignant endocarditis. 1504[48] is from the same case, and is probably an aneurysm in the submucous tissue of the bowel.

All the specimens of disease of the nervous system are of much interest. 1562[92 & 93] are preparations of syringo-myelus from two cases. It will be remembered that Dr. Taylor presented specimens of a similar condition last year. I may take this opportunity of saying that the museum is particularly indebted to Dr. Paddison not only for these specimens, but also for others not yet mounted, and also for some series of slides from cases of sclerosis of the spinal cord which have been added to the cabinet of histological specimens in the post-mortem room.

1584[51] is a well-marked example of nodular syphilitic arteritis, 1590[17] one of chronic basal meningitis.

1620[61] is the hand of a leper, showing the characteristic ulceration and deformity of the fingers; it was presented by Dr. Beavan Neave Rake, of the Leper Asylum at Trinidad, and amongst the specimens sent by the same gentleman are also two examples of chronic laryngitis from leper patients 1699[5 & 6].

1684[5] is an example of fracture of the larynx, hitherto considered to be rare and fatal, but which Mr. Lane has shown by careful observations on subjects in the dissecting room to be attributes which do not necessarily attach to such injuries.

1784[75] may be noted as an example of adenoid vegetations

about the pharynx, a disease the frequency of which is much insisted upon, but which is a rarity in museums.

1697[23] is another important preparation illustrating a somewhat uncommon after-result of tracheotomy. The child had been in the hospital some time previously, and tracheotomy had been performed. The breathing had lately again become embarrassed, and it was brought in dead. Two strictures are seen in the windpipe.

1738 is of historical interest, and to the majority of those who read the 'Guy's Hospital Reports' something more, in coupling the names of Addison and Wilks.

1817[56] and 1819 are two rare specimens of congenital occlusion of the small intestine, the former presented by Mr. George Eastes, the latter by Dr. Hobson.

1844 is an interesting specimen of typhoid fever, which has been already recorded in the last volume of the 'Guy's Hospital Reports' by Sir William Gull, and 1851[98] is another rare specimen of intestinal lesion from the same donor and recorded in the same volume.

The remainder mostly tell their own tale, and I shall only mention 2351[59] as a very rare specimen of bony deposit in the testis (body and epididymis) presented by Dr. Price. The other testis was affected similarly. It is recorded in the 'Transactions of the Pathological Society,' vol. xxxvi.

I must not conclude this summary of the work that has been done without saying, as in former years, how much the museum is indebted to the Museum Superintendent, Mr. Betts, for his careful and orderly supervision of its numerous parts, and to him and to his assistant, Mr. Hunt, for the care that is represented by this annual display.

1000[36–39a]. Five Preparations showing the Spine, Upper Extremity, Lower Extremity, Lower Jaw, and Rib, from a case of bone disease of uncertain nature. ? Mollities Ossium. ? Late Rickets. *Mr. Davies-Colley.*

1007. Part of a Spine with an Antero-Posterior Curve in the Dorsal Region. The bodies of the affected vertebræ are much narrowed anteriorly. From a man aged 27. His work was one involving much stooping, and

he also suffered from old pleuritic adhesions and sacculated dilatation of the pulmonary artery.

Dr. Pye-Smith.

1027. A small piece of the Spinal Column in Section and the corresponding part of the Spinal Dura-Arachnoid. The vertebra, which lies between the two fragments, is condensed, yellow, and partially excavated, and the margin of the spinal foramen is rough looking, as if diseased. The outer surface of the membrane is thickened by a mass of tough yellow material. The nature of the disease is uncertain. It bears some resemblance to the product of slow caseous inflammation of scrofulous nature; but the tough nature of this, and the dense appearance of the bone, link it rather with chronic syphilitic ostitis as it is sometimes seen in the sacrum and other bones.

Dr. Hale White.

1042[51]. Osteo-Sarcomatous Tumour growing in front of and behind the Sternum. *Dr. Wilks.*

1045[5]. The Lower Four Cervical and First Dorsal Vertebræ with a Rudimentary Rib, in position on the Right Side of the Seventh Cervical. *Mr. Arbuthnot Lane.*

1069[21]. Calvaria and Other Bones from an old Woman affected with Ostitis Deformans. *Dr. Goodhart.*

1069[22]. The Long Bones and Patella of the Right Lower Extremity, from the same patient. *Dr. Goodhart.*

1091[76]. Part of a Lower Jaw with Extensive Epitheliomatous Ulceration of the Lip. *Mr. Jacobson.*

1098[16]. Sarcomatous Tumour of the Scapula. *Mr. Symonds.*

1117[43]. A Colles' Fracture of the Lower End of the Radius.

Mr. Clement Lucas.

1134[10]. Fracture of the Left Innominate Bone through the Acetabulum. *Mr. Durham.*

1177. Intra-capsular Fracture of the Neck of the Femur, in which the periosteum still remains continuous at the posterior aspect of the neck. *Mr Howse.*

1187[53]. Fracture (Extra-capsular) of the Neck of the Femur, forty-nine days old, from a woman, aged 87.

Mr. Durham.

1252[25]. Section of a Tibia to show the Medulla invaded by

Secondary Growth. From a man, aged 54, with osteo-sarcoma of skull, vertebræ, ribs, clavicle, &c.

Dr. Wilks.

1268[5]. An Old Oblique Fracture of Lower End of Tibia and Fibula, with Partial Displacement Backwards of the Foot. *Mr. Arbuthnot Lane.*

1284[22]. A Section of a Stump after Pirogoff's Operation.

Mr. Davies-Colley.

1284[64]. General Ankylosis of Tarsal Bones with Considerable Excavation on their Outer Aspect, the Result of a Gun-shot Wound Thirty-five Years before Removal.

Mr. Bryant.

1325[50]. A Knee-Joint showing the Effects of Chronic Inflammation of the Synovial Membrane. There is considerable erosion of the central parts of the cartilages, but the hypertrophy of the Synovial Fringes is the noticeable feature of the preparation. From a woman aged 57. Admitted for severe osteo-arthritis, for which one foot was amputated, with a fatal result.

Mr. Bryant.

1376[71]. Recurrent Sarcoma from the Thigh.

Mr. Clement Lucas.

1394[29]. A Much Hypertrophied and Dilated Heart with Fibroid Change in the Wall of the Left Ventricle, from the same patient as 1450[88].

1400[30]. Rupture of the Septum between the Ventricles. From a boy, aged 8, who was run over by a cart. He lived twenty-one days after the accident.

Dr. Moxon.

1407[10]. Malignant Endocarditis. The peculiarity about the specimen is that it occurred in a child aged 10 years, and malignant endocarditis is stated to be rare in children.

1445[51]. A Section of a Heart and Pericardium, with the latter much thickened and studded with tubercles.

Dr. Pye-Smith.

1450[42]. A Dilated Pulmonary Artery, from a man, aged 73, who had severe capillary bronchitis.

Mr. Jacobson.

1450[43]. A Base of a Heart with a greatly Dilated Pulmonary Artery. From a woman of 57, with pleuritic adhesions, hydrothorax, and small lungs. *Dr. Pavy.*

1450[44]. A Heart and Great Vessels with a largely Dilated Pulmonary Artery. *Dr. Pavy.*

1450[44a]. A Section of Lung showing the Dilated Extremity of the Pulmonary Artery before Branching. *Dr. Pavy.*

1480[12]. Aneurysm of the Intra-Pericardial Portion of the Arch of the Aorta, which has grown in two directions, forwards and to the left by a large sac; downwards, forwards, and to the right by a smaller one. The latter occupies the position of the auricular appendix. *Dr. Wilks.*

1480[57]. The Base of a Heart with an Aneurysm of the first part of the Aorta opening into the Pulmonary Artery through an Adherent Pulmonary Valve. *Dr. Mahomed.*

1480[58]. Aneurysm of the Aorta beyond the Left Subclavian, which has grown towards the pericardium, and opened into the pulmonary artery at the lower part of the sac. *Dr. Goodhart.*

1487[16]. An Aneurysm of the Descending Thoracic Aorta. *Dr. Taylor.*

1493[26]. Aneurysm of the Abdominal Aorta with the Cœliac Axis Projecting from the Dependent and Lateral Part of the Sac. The sac is full of clot. The patient was only under treatment a few days, and then for thoracic aneurysm. He died from pulmonary complications. (Prep. 1480[58].) *Dr. Goodhart.*

1501[23]. Sections of the Left Carotid and Subclavian at their Origin and of the Subclavian beyond. The carotid is nearly obliterated and the subclavian considerably narrowed by a well-organised thrombus. *Dr. Wilks.*

1501[56]. Aneurysm of the Right Sylvian Artery causing death by Meningeal Hæmorrhage. From a woman aged 47. The heart was healthy. The kidneys questionable. *Dr. Pye-Smith.*

1501[64]. A Large Aneurysmal Sac from the Right Middle Cerebral Artery from a man, aged 31, the subject of Malignant Endocarditis. *Dr. Wilks.*

1504[47]. A part of a Stomach with its Mucous Membrane protruded by a large, flat, fleshy mass, in the centre of which is an ulcer. The tumour is an aneurysm of the splenic artery full of clot. From a case of malignant endocarditis. *Dr. Pavy.*

1504[48]. A small Mass, probably an Aneurysm, from the Small Intestine of the same patient. *Dr. Pavy.*

1519[1]. Aneurysm of the Common Femoral Artery for which the External Iliac was ligatured eight days before death. *Mr. Bryant.*

1562[92]. Sections of Spinal Cord with Syringo-Myelus. *Dr. Paddison.*

1562[93]. A Similar Preparation from another case. *Dr. Paddison.*

1567[56]. Two Sections of the Right Hemisphere of the Brain with a Clot in the Right Frontal Lobe. From a case of heart disease. *Dr. Wilks.*

1580[77]. The Left Half of a Brain with the Insula and Posterior Part of the Third Frontal Convolution softened and shrunken. From a case of general arterial disease. The patient had suffered from aphasia. The specimen is preserved because the lesion is so strictly localised. *Dr. Moxon.*

1584[51]. The Vessels at the Base of the Brain with the underlying parts of the Pons and Crura. The vessels are several of them thrombosed and nodulated by the growth of gummatous masses in and around them (syphilitic arteritis). One of these masses (a large one), by means of the section which has been made, may be seen buried in the pons. Another is shown on the posterior aspect of the preparation, the vessel having been cut across transversely. *Dr. Mahomed.*

1590[17]. Half of a Bulb and Cerebellum from a case of Chronic Basal Meningitis showing the adhesion and thickening of the Pia Arachnoid over the Cerebellum and around the Spinal Cord. *Dr. Moxon.*

1620[61]. The Hand of a Negro Leper with Ulcers on the Knuckles and Extremities of the Fingers.
Dr. Beavan Neave Rake.

1649[89]. A Nævus from the Interior of the Cheek. The mucous membrane is seen at the upper part of the preparation, the V-shaped aperture above being the angle of the oral aperture. The nævus is the dark-coloured projection below; it had been cauterised. *Mr. Howse.*

650[26]. Large Papillomatous Tumour from the Back. From a man, aged 54, who died of osteo-sarcoma of many of the bones. *Dr. Wilks.*

1652[81]. A Lobulated Congenital Fibro-Sarcomatous Tumour removed from the Lower Part of the Back.
Mr. Davies-Colley.

1652[82]. Section of a Myxo-Sarcoma removed from the Thigh.
Mr. Clement Lucas.

1655[51]. A Keloid Tumour from the Nape of the Neck of a Boy aged 12 years. *Mr. Golding-Bird.*

1661[10]. Melanotic Tumours from the Sole of the Foot.
Mr. Bryant.

1674[7]. Epitheliomatous Ulcer on the Left Side of the Tongue. The tongue is generally fissured, the papillæ large, and the mucous membrane thick. *Mr. Bryant.*

1684[5]. Fracture of the Superior Cornua of the Thyroid Cartilage. *Mr. Arbuthnot Lane.*

1685. Extreme Ulceration of Larynx and Pharynx with Necrosis of the Laryngeal Cartilages. *Mr. Bryant.*

1697[23]. A Larynx and Trachea of a Child opened from behind to show two Cicatricial Stenoses the result of Ulceration after Tracheotomy. The upper scar, which is still not healed, was at the seat of operation. The lower probably corresponds to what would be the lower end of the tracheotomy tube. The child, aged 2 years, was brought in dead.

1699[5]. The Tongue and Larynx of a Leper. The tongue is much tuberculated, the epiglottis ulcerated at its tip, and the rima much narrowed by a general thickening of the Aryepiglottic Folds. *Dr. Beavan Rake.*

1699[6]. The Larynx of a Leper showing Ulceration of the Epiglottis and about the Arytenoid Cartilages, with a general thickening of the Mucous Membrane.
Dr. Beavan Neave Rake.

1713[69]. Extreme Syphilitic Stenosis of the Trachea.

1715[5]. Simple Ulceration between the Trachea and Œsophagus.
Dr. Carrington.

1738. The Lungs of a Cat which died of Consumption. The preparation was mounted by Dr. Wilks for Dr. Addison as an illustration of pneumonic phthisis.
Dr. Wilks.

1784[75]. Hypertrophy of the Mucous Membrane of the Posterior Wall of the Pharynx from a Male Infant of sixteen months. *Dr. Goodhart.*

1792[50]. Cancer of Œsophagus Ulcerating into Left Bronchus. An œsophageal tube had been worn and a vertical ulcer is seen in the mucous membrane covering the pharyngeal aspect of the right side of the larynx.
Mr. Durham.

1817[56]. Congenital Occlusion of the Duodenum.
Mr. George Eastes.

1819. Congenital Occlusion of the Small Intestine.
Dr. Hobson.

1832[53]. A Piece of Small Intestine which is Kinked and Strictured, and which was Obstructed by a Band. Laparotomy was performed and the band divided, the patient being relieved. He died five days after the operation. *Dr. Mahomed and Mr. Symonds.*

1833. Lardaceous Disease of the Intestine. The specimen has been partially stained. *Dr. Goodhart.*

1844. Intestine from a case of Typhoid Fever in which the Ulcers show three or four Distinct Stages.
Sir W. Gull, Bart.

1847. A Piece of the Ileum just above the Ileo Cæcal Valve. It formed an intussusception, and is mounted to show the swollen state of the glands resulting. The Peyer's patch most affected still shows a dimple on the peritoneal aspect probably indicating the commencement of the intussusception. *Mr. Howse.*

1851[98]. Valvulæ Conniventes detached in consequence of Thrombosis of the Mesenteric and Renal Veins. *Sir W. Gull, Bart.*

1854[82]. A Piece of the Colon with numerous Sacculi of its Mucous Membrane. *Dr. Hale White.*

1881[57]. A Calculus from the Vermiform Appendix removed during life. *Mr. Symonds.*

1881[58]. A Grain of Corn which had set up Ulceration and Perforation of the Cæcal Appendix terminating in Intestinal Obstruction. *Dr. Hale White.*

1986[75]. A Gall-Stone which caused symptoms of Intestinal Obstruction, but which was afterwards passed per anum. *Mr. Hearnden.*

2028[25]. A Sacculated Scrofulous Kidney with a portion of thickened Ureter removed during life. *Mr. Lucas.*

2077[37]. A very Large Branched Calculus from the Pelvis of the Kidney, consisting mainly of Triple Phosphate. *Dr. Hale White.*

2077[45]. Phosphatic Calculus weighing eighteen grains removed from the Kidney by Nephro-Lithotomy. From a man aged 50. *Mr. Symonds.*

2104[27]. A Bladder entirely full of Soft Growth. *Mr. Durham.*

2104[37]. Villous Growths removed from the Bladder. *Mr. Bryant.*

2104[38]. Villous Growths removed from the Bladder. *Mr. Bryant.*

2104[39]. A Villous Growth removed from the Bladder. It has a long and stout pedicle. *Mr. Davies-Colley.*

2249[32]. A Solid Sarcoma of the Ovary removed from a child of about six years. *Dr. Goodhart and Mr. Lucas.*

2300[47]. Colloid Tumour of the Breast. *Mr. Howse.*

2351[59]. A Testis much Disorganised by Chronic Inflammation and containing a large Nodule of True Bone in the Body and Epididymis. The other testis was similarly affected. *Dr. Parry Price.*

2398[5]. A Bladder from an old case of Stricture Dissected to show a Compound Diverticulum in connection with the Prostatic Urethra. The dissection is by Mr. Arbuthnot Lane. *Mr. Davies-Colley.*

2444. Intestinal Obstruction. A loop of Small Intestine passing under an old Adhesion between the Right Broad Ligament and the Rectum. *Dr. Goodhart.*

2486[22]. Reduction *en masse* of a Strangulated Inguinal Hernia. The dissection is by Mr. Poland. *Mr. Davies-Colley.*

2506[73]. The Contents of an Umbilical Hernia (transverse colon) in which the Mucous Membrane was Gangrenous, the bowel containing a large quantity of melon seeds. *Mr. Davies-Colley.*

SOME POINTS

IN THE

PHYSIOLOGY AND PATHOLOGY

OF THE

CHANGES PRODUCED BY PRESSURE

IN

THE BONY SKELETON OF THE TRUNK AND SHOULDER GIRDLE.

By W. ARBUTHNOT LANE, M.S.

In a paper[1] in the sixty-seventh volume of the 'Transactions of the Medico-Chirurgical Society,' I described three distinct groups of changes in the spinal column. These occurred in three different classes of labourers, and were produced by the manner in which they each carried heavy loads. In the first class the load is carried on the shoulder, in the second upon the back, and in the third upon the head.

Since I wrote that paper I have observed many other changes which occur in each form, and have been able to separate out a fourth distinct group of labour changes. It is rare to find this type alone, as it is usually combined with the second form already described. In this paper I intend to describe very fully the changes present in these three groups, those present in the fourth group I have since observed, and

[1] "Three forms of Spinal Deformity."

then to compare these last with changes that resemble them superficially, but which prove to be very distinct on more careful examination. After these I will describe briefly the pathology of curvatures and other changes produced by contraction of the sterno-mastoid and of portion of the pleural cavity.

The skeletons of labourers who perform hard manual labour present very interesting changes. We shall do well to study them in detail, and attempt to apply the principles observed in order to explain many obscure but very important points in the pathology of the osseous system. The great groups of changes I am about to describe have been relegated by pathologists as instances of several vague and indefinite conditions. Many were regarded as instances of what is called rheumatoid arthritis, others were looked upon as being examples of abnormalities in the development of the parts affected, and others again were supposed to be the result of fractures. In a paper[1] in the 'Transactions of the Pathological Society,' 1884, I attempted to prove that rheumatoid arthritis and Charcot's disease were but modifications of the same condition, dependent on different degrees of vitality of the osseous system, and on variations in the amount of sensibility of the parts affected by the so-called disease. In the discussion[2] on the subject which took place more than a year later at the Clinical Society, and which is reported in the 'Transactions' of that Society for the year 1885, the majority of the speakers expressed similar views as to the identity of the two conditions.

In another paper[3] in the 'Transactions of the Pathological Society,' 1886, I have gone a step further, and have tried to prove that there is no such disease as rheumatoid arthritis, but that the conditions which are regarded as constituting that disease are inseparable from and identical with the changes produced in the osseous system by pressure.

How far I have proved my point I will leave it to the

[1] "Partial Mollities, Rheumatoid Arthritis, and Charcot's Disease."

[2] Discussion on Charcot's disease.

[3] "The Causation and Pathology of the so-called Disease Rheumatoid Arthritis," with a sequel on "Senile Changes."

reader to decide. Whatever opinions he may hold on the subject he will at all events agree with me that a large number of the conditions I shall describe and figure in this paper which are evidently the result of transmitted pressure, have been described by pathologists as rheumatoid arthritis.

I am indebted to the courtesy of the Councils of the Royal Medical and Chirurgical, and of the Pathological Societies for permission to make use of several drawings contained in my previous papers published in the 'Transactions' of these Societies.

If we examine the bodies of labourers who have died before their osseous tissues, like their other tissues, have begun to show well-marked degenerative changes, we find that their bones are dense and strong, and that that portion of a bone which transmits the greatest weight is relatively much denser than that which transmits less weight; also that the former portion frequently increases in size if such an increase is necessary in order that its functions may be efficiently performed. We shall see that by examining bones we can judge from their form and texture as to whether they have transmitted exaggerated weight or heavy loads, and if so, in what manner those loads have been supported on the trunk. *In fact, in labourers, we can detect their previous career of labour. I need not point out the value of these facts from a medico-legal and also from an archæological aspect.*

I have been able to find instances of these definite changes in very old bones, and even in the mummy.

The most common group of changes appear to be those produced by carrying weights on one or other shoulder, usually on the right. In the first sixty cases I examined the changes characteristic of this group largely predominated over those of the other two groups, but in the second sixty I found that the physical changes which had been produced by carrying loads on the back were at least equal in number to those of the first group. A brewer's drayman furnishes a very good instance of the labourer who carries loads on the shoulder.

Before examining the bones we shall observe the manner in which such a man carries his load, which is in this case a

barrel, on his right shoulder. We see that the load rests upon his right shoulder and upon the upper part of his chest. His head and neck are thrown forwards and to the left, and the upper part of the dorsal spine shares in this forward movement.

The spines of the dorsal vertebræ can be felt to form a convexity to the right side, the most prominent portion of this lateral curve corresponding usually to the spine of the seventh dorsal vertebra. There is no perceptible lateral curve to the right side in the lumbar region, the only apparent curve being single and being limited to the lower cervical and to the whole of the dorsal regions. Neither is there any compensatory lumbar curve. The right half of the chest is thrown backwards in order to act more efficiently as a prop or support for the load, while the left half of the chest projects forwards. The right arm, and frequently the left also, is raised to assist in supporting and steadying the load.

The centre of gravity of the body and burden, since the latter acts to one side of the middle line, appears to fall in the same line and through the same point as does that of the body alone. If anything, it falls a little behind the normal. Examining the body after death we find that the spinal column presents a single large lateral curve to the right (see Fig. 1). (In cases in which the load is carried on the left shoulder, the conditions are exactly the reverse of those described here.) The bodies of the vertebræ form a very much more marked curve than do the spinous processes. The point of greatest convexity of the curve corresponds to the body of the sixth or seventh dorsal vertebra. The upper and lower extremities of the curve correspond usually to the seventh cervical and to the third or fourth lumbar vertebræ, but the lateral deviation of the upper lumbar vertebræ from the median line is very slight indeed in the majority of cases. Therefore it is not a uniform lateral curve, as the greatest lateral deviation from the middle line is nearer its upper than its lower extremity. There is also a considerable and abrupt increase in the antero-posterior direction in that portion of the curve which is most prominent laterally. The lumbar curve is diminished. As we have just seen, the lateral curve is not uniform, as it deviates more from the middle line above

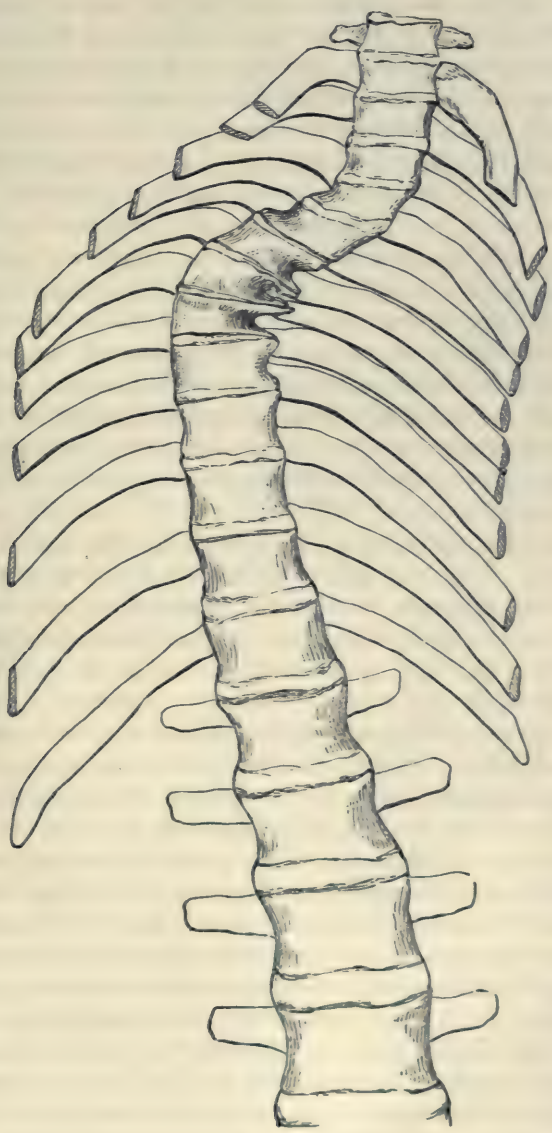


FIG. 1.

than it does below. It also presents a break in its otherwise regular outline, producing a curve whose convexity is to the left. On examining the mechanism by which the weight is transmitted by the ribs to the vertebral column, the mode of formation of this curve, which we will call a *secondary curve*, is obvious. When a heavy load is supported upon the shoulder of what I may describe as a normal subject—and by that I mean one whose skeleton is not in any way deformed by the transmission of heavy weights—we find that the dorsal spine forms a lateral curve with its convexity to the right, and that the chest is placed obliquely in a transverse plane, the right side projecting backwards, and the left side forwards. This rotation round a vertical axis of the bodies of the vertebræ to the right has been necessarily accompanied by a projection backwards of the ribs which are attached to the bodies and transverse processes of these vertebræ, and a corresponding projection forwards of the ribs articulating with the concavity of the lateral curve.

The weight, pressing partly directly on the upper ribs on the right side, and partly indirectly by means of force transmitted through the clavicle, manubrium, and first and second costal arches, forces them downwards and forwards, in a direction the reverse of that in which they have been carried in order the better to support the load. Now, these ribs act as powerful levers on the bodies and transverse processes of the vertebræ with which they are connected, and they consequently cause the bodies to be rotated round a vertical axis to the left, namely, in a direction the exact reverse of the rotation they have primarily undergone. The heavier the load the greater will be the *primary* and *secondary rotations* of the vertebræ. By means then of this leverage action of the upper ribs a portion of the general lateral curve is reversed, and a small secondary curve is produced. Accompanying the reverse rotation of these bodies, you get a consequent modification in the direction of the ribs on the left side which articulate with them. In some cases the convexity of this upper or *secondary* curve extends to the left of a line joining the extremities of the long curve or *primary curve*. As we observed in the living subject, we find here that the spinous processes present a lateral curve corre-

sponding in general character to the curve formed by the bodies of the vertebræ, but the deviation from the middle line is not so extensive. The manner in which a vertebra rotates either through movement taking place primarily between the bodies of the vertebræ themselves, or taking place as the result of leverage exerted on the vertebræ by the ribs, explains the reason that the curve formed by the tips of the spinous processes is not nearly so marked as that formed by the bodies of the vertebræ.

Examining the chest from the front we see that the left side is thrown a little forwards, but owing to the reverse rotation forming the secondary curve the general chest deformity is very slight as compared with that present in subjects whose dorsal spine presents a single lateral curve as in a case of ordinary lateral curvature. This is so much the case that a subject may have the greatest deformity I have yet seen produced in this class of labour, and the chest examined from the front before dissection may show nothing abnormal in its appearance, even to one accustomed to look for changes of this sort.

Examining the bodies of the upper seven or eight dorsal vertebræ we find that they are all altered in shape and texture, the amount varying with the degree of the curve. The left sides of the bodies of the sixth, seventh, and eighth dorsal vertebræ are much diminished in depth, and from the left margins horizontal processes of bone, which vary in size within broad limits, grow towards the left, and articulate with one another, strengthening the bony arch along its concavity. The bodies are very dense. In some cases the bodies of the sixth and seventh dorsal vertebræ are quite triangular on transverse vertical section. The bodies of the upper five dorsal vertebræ which form the upper or secondary curve are deeper on the left than on the right side, where they are much diminished in depth, but not to the same extreme extent as those just described. The fibro-cartilages between the upper eight dorsal vertebræ are also much diminished in thickness, those between the fifth, sixth, seventh, and eighth dorsal vertebræ being very thin, and often in the left half almost entirely absent. They may present a horizontal cavity in their centre. The transverse

DESCRIPTION OF PLATE V,

Illustrating Mr. Arbuthnot Lane's Paper on the Pathology of Changes produced by Pressure in the Bony Skeleton of the Trunk.

FIG. 1.—In this drawing the body of the fifth lumbar vertebra, with the superjacent column, is displaced backwards from the body of the first piece of the sacrum, producing a condition the reverse of spondylolisthesis. The spinous processes of the lumbar and sacral vertebræ are enormously hypertrophied, and are connected to one another by a thin layer of dense ligamentous tissue, forming amphi-arthrodial joints through which much of the weight of the body is transmitted.

FIG. 2.—The fifth lumbar vertebra and superjacent column are displaced forwards from the body of the first sacral vertebra, from the upper and anterior margin of which a long shelf projects to support the displaced vertebra. The intervertebral substance has been divided horizontally, and the joint has lost its amphi-arthrodial character. The calibre of the last intervertebral foramen is much diminished.

FIG. 3.—In this specimen the fifth lumbar vertebra has been similarly displaced, but, instead of the lumbo-sacral articulation having become arthrodial in character, it belongs rather to the class synarthrosis, as the fibro-cartilage has been almost completely removed. The lamina is seen to be divided into three portions, the small anterior portion helping to obliterate the intervertebral foramen.

FIG. 4.—The anterior portion of the body of the fifth lumbar vertebra is displaced forwards, giving the appearance of spondylolisthesis. There is, however, no growth of bone from the anterior superior margin of the sacrum. The posterior portion of this lumbar body and the superjacent column are displaced backwards.



Fig. 1.



Fig. 3.



Fig. 2.

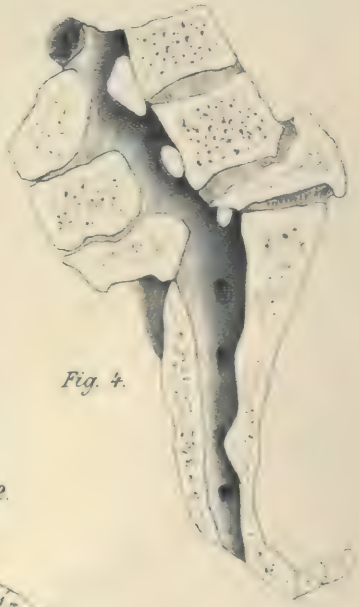


Fig. 4.

W. A. L. del.

processes of the upper six dorsal vertebræ have yielded somewhat to the powerful leverage action of the ribs, so that they are bent a little downwards and forwards from their relative position to the bodies of their respective vertebræ.

The laminæ and spinous processes of the second, third, fourth, fifth, sixth, and seventh dorsal vertebræ which correspond to the convexity of the increased antero-posterior curve are much increased in depth, while the ligamenta subflava, the interspinous, and the supraspinous ligaments are much shorter than normally. In some cases processes of bone may develop in the ligaments at their attachments, and these may extend a variable distance into them, and may blend or fuse with similar processes from adjacent vertebræ. The whole purpose of the formation of the lateral and antero-posterior curves is to form a strong bony shelf on which the weight can be supported, economising as much as possible muscular energy. Since the load is borne on the shoulder, as we have previously observed, the increased antero-posterior dorsal curve prevents the centre of gravity of the combined body and weight being thrown in front of the normal position of the centre of gravity of the body alone, but if anything causes it to fall a little behind the normal.

Examining the lower dorsal and lumbar spine you find their bodies form part of the general curve to the right. They are very dense, but their anterior margins present no lipping and the fibro-cartilages appear perfectly normal or only diminished in depth. This diminution in depth is most marked in the lowest intervertebral discs. The normal convexity of the lumbar spine appears to be slightly diminished.

The sacrum is large and well formed, the spinous processes prominent, and the canal covered in more completely than in the normal subject by the junction of the bony laminæ above and below. On making a vertical median section of the lumbar and sacral spine in a very marked case of this form of labour curve, we see (as in Fig. 1) that the spinous processes of the sacral and lumbar vertebræ are enormously increased in size and in density of structure. The lumbar spinous processes are no longer separated by interspinous ligaments, but articulate with one another by broad opposing

flat surfaces, connected by a thin layer of dense fibrous tissue, or they are each covered by cartilage and connected to one another by a fibrous capsule lined by a synovial membrane. The same form of articulation exists between the spines of the last lumbar and first sacral vertebræ.

The ligamenta subflava are very much diminished in depth owing to the increased size of the laminæ.

The articular processes also present marked changes in the direction and form of their articular surfaces. Those of the sacrum are much increased in depth, are flattened, and look towards one another. The surface of each is continuous with an articular surface on the lamina of the first sacral vertebra, and it extends anteriorly beyond its normal position.

The lower articular processes of the fifth lumbar vertebra present corresponding changes. Each articular surface is continuous above with a deep depression in the under aspect of the root of the transverse process at its junction with its lamina, and this depression receives the flattened extremity of the sacral articular processes. The lower articular processes of the fifth lumbar vertebra are also flattened at their extremities, where they articulate with the depressions on the upper aspect of the sacral lamina.

Similar changes, though decreasing in extent, are seen in the form of the articular processes of the other vertebræ.

The bodies of the upper four lumbar vertebræ do not differ from the normal, while that of the fifth presents compression changes at its posterior margin. The third and fourth lumbar fibro-cartilages are thin posteriorly, while the fifth is considerably thinned throughout, and particularly so in its posterior part. You also find thin bony laminæ projecting back from the opposing posterior margins of the bodies of the fifth lumbar vertebra and sacrum, and these are connected by ligamentous tissue posteriorly. In extreme cases the body of the fifth lumbar vertebra is displaced backwards as in fig. 1, Plate V. In either case a prominence is produced which diminishes the calibre of the spinal canal, and this, together with the enlarged sacral articular processes, diminishes the size of the lower part of the intervertebral foramina. The fifth lumbar nerve is not compressed.[1]

[1] It is obvious from the examination of this and similar specimens, and as

These changes in the lumbar spine and sacrum show that the centre of gravity falls a little behind the normal position, and that much of the weight that is usually transmitted through the bodies of the lumbar and sacral vertebræ is transmitted through the spinous processes, laminæ, and articular processes, which are enormously enlarged and considerably altered in their form and functions.[1]

While in the dorsal region the front and sides of the bodies suffer from compression changes, in the lumbar and sacral articulations the posterior portions of the vertebral bodies are affected by the pressure changes. I would especially call attention to the particular vertebræ affected, and to the manner in which they are affected by pressure as indicating the lines along which that pressure is transmitted when force is applied to the right shoulder in the direction of the pressure exerted by the load. In those who carry the weight on the left shoulder the direction of the lateral curves with the other alterations in the chest wall are reversed. In the sacro-iliac joints it is by no means uncommon to find much bossing along the line of the sacro-iliac articulation on its upper surface, and in some cases this joint may be completely locked at this point. Less frequently we find more complete fusion of this articulation and of the symphysis. When this fusion has been present in this form of labour on one or both sides the pelvis has presented no asymmetry whatever in any subject I have yet examined. The cause of the bony deposit and final locking

I will show later the same holds true for the cervical region also, that the posterior portions of the bodies of the vertebræ are very liable to injury during the movements of vigorous adult life. This fact is not recognised. In the article in 'Holmes's System' on Spinal Disease, I find the following description of a case of caries:—"I may mention that this is a comparatively rare specimen, in one respect particularly, *i. e.* it shows a distinctly isolated form of caries starting on the *posterior* aspect of a vertebral body, the anterior and other parts of which are perfectly sound. The same condition of things, due to syphilitic disease, will be alluded to presently. *This could not possibly have been the result of injury, as one is unable to suppose the back of a vertical body being injured while the front is intact.*" The italics are mine. In syphilis, the injury received by the posterior part of a vertebral body, usually at its margin, determines the seat of gummatous growth, as it does that of tubercle or caries. My experience certainly bears this out.

[1] I have treated the developmental aspect of these changes in my paper in the 'Transactions of the Pathological Society' for the year 1886.

is, as in the spinal column, pressure in a severe form. As elsewhere it causes destruction of the intervening fibro-cartilage, and fusion of the opposing bony surfaces.

Another change produced by pressure in this class of curvature is an alteration in the form of the sternum. In the cases in which it is present the occupation has probably been commenced at an early period, and the pressure exerted by the first ribs and cartilages being the pressure exerted directly by the weight upon the first rib and indirectly by the weight through the clavicle has caused the first piece of the sternum to appear as if it had yielded slightly along a transverse axis, so much so that in well-marked cases a vertical section of the sternum is not very unlike that of a sternum from a subject with mollities ossium with exaggerated flexion of the dorsal spine.

For further details and diagrams (Figs. 5 and 6) showing the modes of transmission of pressure from the clavicle to the upper ribs, sternum, and upper dorsal spine, I would refer the reader to the description of the pathological conditions presented by labourers who carry loads on the upper part of their back. In that description and in a further detailed account in a subsequent portion of this paper I have shown the action of flexion of the upper dorsal spine in approximating the upper two ribs, and in rotating the manubrium around a transverse axis, so giving it the peculiar form just mentioned.

In the more usual case of the labourer who carries his load on his right shoulder, the first rib presents on its upper surface immediately outside the costal cartilage, and behind the insertion of the tendon of the subclavius, a defined flat eminence. The under surface of the clavicle possesses a facet which corresponds with the facet on the rib and articulates with it. These opposing facets are covered with synovial membrane as in the fibrous capsule which surrounds the facets and connects the clavicle to the first rib at this point. By this means an articulation is formed in this class of labourer which does not exist in the normal subject.

The tendon of the subclavius is situated immediately in front of this articulation, and the rhomboid ligament immediately behind it, and both these structures are very frequently more or less destroyed by the pressure of the clavicle, the

rhomboid ligament usually suffering the most. The mode of development of this joint is apparent. A new joint is also formed on the right side between the coracoid process and under surface of the clavicle. The upper surface of the coracoid process between the attachment of the coraco-clavicular ligaments and the tip is rendered smooth and flat, and the under surface of the clavicle for a varying distance backwards, but often as far back as the ridge and tubercle for the coraco-clavicular ligaments, presents a corresponding facet. The fleshy origin of the subclavius muscle lies usually behind this facet on the clavicle, but it is obvious, from an examination of a well-marked case, that a portion of the origin of the muscle from the clavicle is probably often removed by this pressure. This joint is surrounded by a loose fibrous capsule, which with the opposing surfaces of coracoid process and clavicle is lined by synovial membrane. The conoid and trapezoid ligaments often form that portion of the capsule which limits and connects the joint surfaces posteriorly. This joint is formed in the following manner. When the arm is flexed on the shoulder, as in supporting a load in the manner I have previously described, and especially when that shoulder is powerfully depressed by a superjacent load, the upper surface of the coracoid process comes into violent contact with the under surface of the clavicle, owing to the rotation of the scapula round an antero-posterior axis and to the gliding forwards, outwards, and upwards of the plane of the whole scapula upon the chest wall; and it is by the frequent exertion of this movement under such circumstances that this joint is developed.

I believe this last movement is of developmental interest in that by it that portion of the tendon of the pectoralis minor, which at an earlier period of man's history always passed superficial to the coracoid process on its way to its insertion in the humerus (instances of this are occasionally seen), from being frequently compressed between the coracoid process and clavicle acquired an attachment to the coracoid process, the distal disused portion of tendon forming the coraco-humeral ligament.

I have shown elsewhere[1] that even during the lifetime of an

[1] 'Trans. Path. Soc.,' 1886.

individual pressure may cause the separation of a portion of the tendon of the biceps humeri, and convert the separated portion into a ligament.

The formation of the second joint is also of much interest for the reason that it demonstrates the movement of the scapula during extreme flexion of the shoulder-joint. When the man carries the load on the left shoulder the joints are only found on that side, otherwise the left side presents no joint formation.

The Pathology of Changes produced by carrying Loads on the Head.

The labour change I will now describe is the least frequent of all labour changes, or rather, it is rarely that one finds a well-marked instance, though slighter cases are by no means uncommon. It is produced by carrying loads on the head. It is really wonderful to see what heavy weights can be supported in this manner, and apparently without any extraordinary effort.

If one watches a labourer carrying a load in this manner, one sees that he allows his head to sink to a position lower than normal, and that he frequently holds it a little obliquely, the direction of this obliquity varying in different subjects. This labour necessitates the fixation of the articulations of the cervical vertebræ, and this is gained by a series of lateral curves, accompanied in advanced cases by destruction of portions or the whole of the intervening fibro-cartilages and articular cartilages, by the fusion of the opposed osseous surfaces and by the development of bony material in the ligaments so fixing and supporting movable parts. Our museums are full of examples of these conditions, and they are classified as congenital abnormalities, rheumatoid arthritis, displacements of vertebræ, osteophytic growth, &c.

We must first recognise (as we have already observed) the fact that when a vertebra is no longer required to fulfil its normal functions it varies in form and structure and in its connection with neighbouring structures.

The same fact may also be proved as the result of injury. In

the museum of the Royal College of Surgeons there is a skull of an ichneumon in which the atlas had been dislocated from the occiput. As one can easily see it would have been decidedly prejudicial to the animal's interests in life for a new joint to have formed between the atlas and occiput. It was necessary that no movement should take place between these two bones, and this necessity was consequently met by a removal of the opposing surfaces of periosteum, articular cartilage, and synovial membrane, and the union of the opposing bones. In fact the appearances presented by this specimen are exactly those presented by those changes produced in this portion of the cervical spine under the influence of continued pressure.

In spinal columns of labourers carrying loads on the head, the lateral curves in the columns serve two purposes: firstly, they diminish the expenditure of muscular energy, and secondly they enable the individual to walk carrying the load in a more even and less jerky manner.

It is also necessary that the free movement of the head on the atlas should be controlled or limited while the load is being carried. This fixation of the load is at first performed by muscular action which supports the head, and prevents this movement round a transverse axis. After a time, the form of the articular facets on the atlas and occiput alters; they become larger, and they may even become deprived of their articular covering and may fuse together. The arch of the atlas in the same manner becomes fused to the occiput. In some labourers, though fusion may take place between other vertebræ, it does not do so between the atlas and occiput, the change in depth and form of the kidney-shaped facets alone taking place. The odontoid process in some cases articulates with the under surface of the occipital bone immediately in front of the margin of the foramen magnum, and a distinct round facet is consequently present in that position. These variations in different subjects are probably due to the manner in which they get their loads into position on their heads, and replace them on the ground. The articulation between the atlas and axis rarely unites by bone, as obviously there is no necessity to fix this joint, the load not tending to cause rotation.

Before proceeding further we will examine a specimen which presents many of the typical changes observed in this form of labour. Fig. 2 and Fig. 3 are drawings of the specimen.

The facets on the atlas and occipital bones are increased somewhat in area, but otherwise differ but slightly from the normal, except in being very asymmetrical.

The opposing articular surfaces of the atlas and axis present pressure changes, being rendered flatter and more extensive than normal. The axis and third cervical vertebra are fused together, their bodies being placed obliquely to one another, so that their right transverse processes are nearer to one another than their left. Below this the cervical spine presents a convexity to the right, the body of the sixth cervical vertebra forming the centre of the arc. On making a transverse vertical section the bodies and fibro-cartilages display the pressure changes always present in a pressure curve, the left halves of the bodies with the fibro-cartilages corresponding to the concavity of the curve being diminished in depth and thickness. Beside these changes there is a gradual increase in the density of the bodies of the cervical vertebræ from below upwards, also in the same order the fibro-cartilages show well-marked and gradually increasing pressure changes. In the lowest cervical fibro-cartilages the deviation from the normal consists in a diminution of their depth, while the fibro-cartilage above this, which is much thinner, has been divided horizontally, so as to form an arthrodial joint, while in the articulations above this the cartilage has been completely removed and the surfaces of bone are in direct apposition. This process is shown in Fig. 3, a vertical median section, and is seen to culminate in the fusion of the axis with the third cervical vertebra. Besides these changes in the bodies of the vertebræ, the laminæ and spinous processes are slightly altered in shape to accommodate themselves to the closely approximated condition while the load is being carried. The articular processes are also slightly modified. In the dorsal region the spinal column presents a compensatory curve with its convexity to the left, and in the lower dorsal and upper lumbar there is another whose convexity is directed to the right. These curves present the ordinary pressure

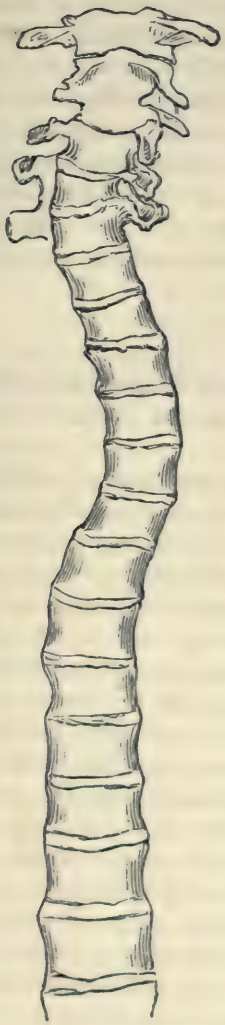


FIG. 2.

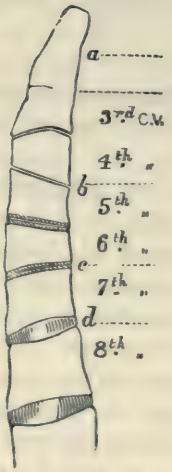


FIG. 3.

changes. The centres of gravity of the body and weight fall through about the same point in the sacro-iliac synchondrosis as do those of the body and weight when the load is carried on the right shoulder. Consequently the variations in the sacrum and the lumbo-sacral articulations are similar to though less marked than those we have already described. This is due to the fact that the weights carried on the head are not so heavy as those usually borne on the shoulders. In many subjects the axis and third cervical vertebra are so fused that their left transverse processes are nearer together than the right, also the laminæ of the left side are more extensively fused than on the right side, but in the majority of cases the condition is fairly symmetrical.

Changes produced in the Spinal Column by carrying large heavy Loads on the Back.

In this form of labour a bulky and heavy load is supported upon the back of the head, neck, chest, and loins. Instances of this class of labourer are very common, and as an example of the class we will take the coalheaver.

If one watches a coalheaver at work, one sees that, when carrying the heavy rigid sack of coals upon his back, his body is bent forwards, and flexed upon the thighs. This is evidently for the purpose of bringing the centre of gravity of the combined trunk and load of coals over the lumbo-sacral articulation so that the weight may be transmitted to the iliac bones and lower limbs. One also sees that the head and neck assist in supporting a large part of the weight, as the man wears a stout tarpaulin cap, which fits his head closely, and there hangs from it behind a long flap made of the same stout material, and covering the upper part of the back. The head is drawn forcibly backwards by the traction exerted by the load upon this flap and cap, while at the same time the neck sustains great pressure in a forward direction by the direct application of the load to it. By this means the head and atlas are levered against the anterior surface of the odontoid process of the axis. At the same time the head is drawn backwards and downwards in the direction of the cervical

spine by the pressure exerted indirectly on the head by the load. The necks of these labourers are always remarkably short, and the relative positions of the head and trunk present very obvious deviations from the normal.

In examining the body after death we find that the occipito-atloid articular facets may be slightly modified. They are usually flattened, and their area is increased. The odontoid process is much altered in form. Its anterior facet is no longer smooth, and does not extend around the front and sides of the odontoid process, but forms a flat facet which is directed forwards. It has an abruptly defined prominent margin. The remainder of the articular surface has quite disappeared. The flat anterior facet is usually devoid of cartilage in well-marked cases, and its surface area is often much increased by the growth of bone around its edge which is commonly regarded as indicating the presence of the disease rheumatoid arthritis. The antero-posterior diameter of the odontoid process is sometimes much diminished by the removal of its anterior portion. The upper extremity of the process is no longer smooth and rounded, but presents in most cases a prominent sharp transverse ridge of bone which is dense and has usually a ragged sharp margin. It is practically a portion of the upper margin of the facet on its anterior surface. In some rare cases, the upper surface of the odontoid process may be flattened transversely, forming an articular surface, which articulates with the under surface of the bone forming the anterior margin of the foramen magnum. This may then present a corresponding depression. The facet on the posterior surface of the anterior arch of the atlas presents the same alterations in form which have been observed in that on the odontoid process. The arch is frequently thinned at this point by the removal of bone from its posterior surface, but in some few cases it has apparently been rendered stouter by a compensatory development of bone on the anterior surface of the arch. Its facet, like that on the odontoid process, is frequently devoid of cartilage, and eburnated. Its area is often increased by the growth of bone on its margin. It is obvious that little or no rotatory movement could take place between such an atlas and axis.

The opposing lateral facets on the atlas and axis are often

flattened, and in some cases their surface area is extended by the development of bone around their margins.

The remainder of the cervical spine is, as one would expect, much altered, and these changes are most marked in the body of the fifth cervical vertebra, and in those in its immediate vicinity.

The bodies and fibro-cartilages of the lower cervical vertebræ present considerable diminution in depth, and this is most marked in the case of the fifth and sixth cervical vertebræ and in the cartilages above and below them. This is due partly to the great forward displacement of the neck at this point, and partly to the pressure exerted on the bodies of the cervical vertebræ at right angles to their superior and inferior surfaces. Much bone is deposited on the margins of these and of the adjacent vertebræ, with the evident object of rendering this portion of the spine more secure. This marginal osteophytic growth forms distinct transverse ridges on the anterior surface of the cervical spine, and transverse projections into the spinal canal, *which may in some cases be sufficiently prominent to interfere materially with its calibre*. In rarer cases this bone formation is not limited to the margins of the vertebræ, but covers the anterior and posterior surfaces of the bodies. As in the case of the marginal growth, this surface growth affects chiefly the fifth and sixth cervical vertebræ. The fibro-cartilages may be thinned, or they may be split horizontally so as to form more or less complete arthrodial joints instead of the original amphiarthrodial ones, or they may be removed in part or entirely, and the bodies of the vertebræ may then become connected by bone throughout part or whole of their extent. In some cases where the pressure is severe and causes fusion of the bodies of the fifth and sixth cervical vertebræ, there is sometimes an extension of bone from the margins of the laminæ encroaching on the ligamenta subflava, and in some instances this may even join with that extending from the adjoining lamina. In this case the articular processes are deprived of their cartilaginous coverings and the opposing surfaces of bone are fused together. Fig. 4 is a very good instance of this extreme condition. I have drawn it in vertical median section so as to show the projections of bone into the spinal canal from the margins of the bodies of the vertebræ. It shows also

the fusion of the bodies of the fifth and sixth cervical vertebræ, the bony layer extending from the margins of their



Fig. 4.

laminæ, and the destruction of the fibro-cartilages, with the other changes I have already described.

In passing from the cervical to the dorsal region, a sudden change in the appearance presented by the anterior surfaces of the bodies of the vertebræ is observed. (See Figs. 5 and 6.)

The anterior surfaces of the bodies of the upper dorsal vertebræ are frequently quite smooth, as in the case of an individual not leading a laborious existence. The upper two thirds of the dorsal spine no longer present a graceful curve, but are now nearly straight. This has been produced chiefly by the direct pressure of the rigid load upon this portion of the column, but partly, also, indirectly by the pressure of the load on the angles of the ribs. I will explain subsequently how the pressure on the angles of the ribs is transmitted to the spine. A large portion of the weight falls on the scapulæ, and this is transmitted to the first ribs, manubrium, gladiolus, and also to the other ribs.

Before proceeding with this description, I will point out a few anatomical facts which I have recently observed, and which I think will explain many factors in this condition and others, including fracture of the sternum. In two papers

in the 'Transactions of the Pathological Society'[1] I have shown very conclusively, both experimentally and clinically, that the large majority of indirect fractures of the sternum are produced by force acting on the clavicle. That force is transmitted to the manubrium and to the first rib and cartilage. The first cartilage by its powerful grip on the manubrium rotates it violently around an antero-posterior axis, and breaks it transversely just above its lower limit. Rivington considers that fracture of the sternum takes place by the extreme flexion of the spine. He argues that the manubrium is held by the strong first costal cartilage, and the gladiolus by the others, and that the flexion of the spine causes fracture by the consequent strain thrown upon the sternum. That fracture may take place in this manner is, I think, possible, though I have failed completely to produce it experimentally, and in the case of fracture produced by injury it seems almost impossible to eliminate the possibility that much of the force was transmitted through the scapula and shoulder. The case that would appear to prove this clinically is that in which a man, while carrying a load on his head, stumbles, his neck is bent forward and broken, and the sternum is also fractured. But even here it is difficult to exclude the previous suggestion that the fracture was produced in the way which requires the application of comparatively little force, namely, the leverage of the clavicle.

I do not intend to go into the subject of fracture of the sternum or first costal arch now, because I intend to describe the mechanism of this fracture in full detail under a special heading in this paper. I refer to it here in order to help to explain a condition which is at first sight obscure. I had always failed to understand why the manubrium is displaced backwards in dislocation, and I did not feel satisfied with the explanation given by Mr. Rivington. I was able to produce this displacement if the dorsal spine was powerfully flexed during the application of the force to the outer end of the clavicle. Now, I observed in the bodies of labourers who carried loads on their backs, and espe-

[1] 'Transactions of the Pathological Society,' vols. xxxv and xxxvi, "One Mode of Fracture of the Sternum," "Mode of Fracture of the First Rib and Cartilage Alone."

cially in the group I will describe later, that the manubrium did not form with the gladiolus a long single unbroken curve, as is the case in subjects who have not led laborious lives; also that in these cases, instead of the articulation between the manubrium and gladiolus being, as it so frequently is in other forms of labour, loose and arthrodial in character, the joint is of the firmest kind, and in many cases the bones are fused to one another. Then, again, the joint or the point of fusion of these bones (as the case may be) does not present a plain surface in front and behind, but forms a very remarkable transverse ridge, which in many cases led me to suspect the presence of a fracture before the skin and soft structures were removed. This indicates plainly that a great deal of pressure is exerted by these bones upon one another at this point. I have never seen this condition of sternum present unless the column presented the changes characteristic of this and similar forms of labour. Of course a great part of the pressure exerted by the manubrium on the gladiolus is transmitted from the scapulæ and clavicles to it, but this alone does not account for the modification in the form and direction of the manubrium. Its anterior surface is not straight or slightly convex as in the normal sternum, but it is slightly concave from above downwards, presenting the appearance as if there was a tendency to the backward displacement of its lower portion. (This condition is seen in a very much exaggerated character in the chest of a subject affected with mollities ossium.) If such sterna be examined in vertical median section it is at once seen that the pressure changes produced in this articulation are characteristic of the disease rheumatoid arthritis, in fact that this joint in this and similar forms of labour is always affected by the disease rheumatoid arthritis. I have discussed this question in detail in the 'Transactions of the Pathological Society,' vol. xxxvii, so will not touch on it here. Figs. 5 and 6 are drawings of such sterna in section. In Fig. 5 the opposing surfaces of the manubrium and gladiolus are seen to be enormously increased in area by the deposit of bone of their margins. The surfaces themselves are rendered very dense, and the intervening fibrous tissue is very tough and scanty. In this intervening fibrous tissue posteriorly and on either side of this section

were small additamentary bones, resembling that seen in Fig. 6.

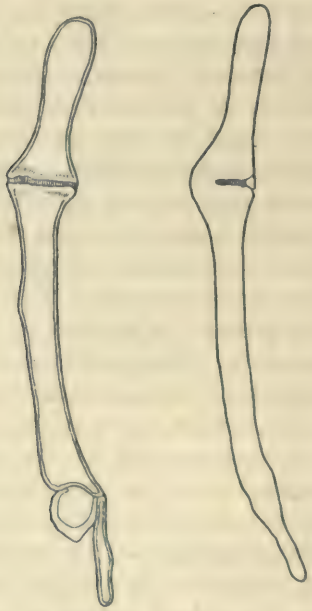


Fig. 5. Fig. 6.

In Fig. 6 the amount of bony growth from the anterior adjoining margin has been so abundant that it has destroyed the intervening fibrous tissue and formed a prominent round boss on the front of the bone. In the remaining fibro-cartilage there was a row of small additamentary bones. In a paper in the 'Trans. Path. Soc.,' 1884, "One Mode of Fracture of the Sternum," I described the mode of development of the mesosternal articulation and of its variations, and in that paper I stated that when the manubrium united to the gladiolus by bone, it did so at a comparatively early period of adult life, in the same manner as did the pleurostea of the gladiolus, and that the joint was never obliterated in advancing age. Since that time I have found that under the influence of great pressure, or, as others would prefer to describe it, owing to the presence of the disease rheumatoid arthritis the fibro-cartilage intervening between

the bones is removed, the opposing surfaces are rendered dense, much deposit of bone takes place on the adjoining margins of bone, osteophytic masses develop in the ligaments, and the adjoining bulky masses of marginal osteophytic callus may fuse together and so obliterate this articulation.

Are there other mechanical factors besides the leverage of the clavicles which assist in producing this great pressure and the alterations in its direction in this articulation? To discover this I removed a transverse piece of the manubrium immediately above the upper border of the second costal cartilages. On forcibly flexing the spine the anterior margin of the lower end of the manubrium was carried downwards and backwards behind the upper extremity of the gladiolus. In flexing the cervical and upper dorsal spine, you advance very considerably the first and second dorsal vertebræ, and especially the first. Consequently you would expect the manubrium, as it is held between the first cartilages, to be advanced forwards and downwards in front of its original position, and to overlap instead of passing behind the gladiolus. If the finger be now placed in the interval between the portions of the sternum, and the neck be again flexed, the finger is severely compressed. At the same time it perceives that there is a force dragging the first rib and manubrium downwards and backwards. On making a hole in the anterior portion of the first intercostal space, introducing the finger, and again flexing the column, it is distinctly perceptible that the structures causing this depression of the first ribs and manubrium occupy the interval between the first and second ribs.

On clearing away the first digitation of the serratus magnus from the first rib and interspace, I found a dense layer of fibrous tissue attached above to the lower margin of the first rib and below to the upper margin of the second rib. It lay exactly beneath the first digitation of the serratus magnus, and gave origin to fibres of this muscle. It did not extend beyond its anterior margin. This ligament consisted of bundles of tendinous fibres whose direction was downwards and backwards. In well-marked cases it forms a very strong layer. On again flexing the spine, as the first rib was projected forwards, it was approximated to the second rib by the action of this aponeurotic layer. It is peculiarly limited to the space

immediately beneath the serratus magnus. It is continuous in front and behind with the fascia covering the intercostal muscles. It is not gradually lost in it, but ends abruptly in front and behind. On removing this structure the external intercostal muscles are seen. The forward movement of the rib is unaffected by them, as their points of origin and insertion are approximated by this movement, and consequently they are relaxed.

On removing the external intercostal muscle, a thin layer of fleshy fibre having the direction of the internal intercostal muscle is exposed, and continuous with it and beneath it, a strong layer of aponeurosis is seen, whose strong bundles of tendinous fibres have the same direction as the fleshy fibres of the internal intercostal muscle. This is evidently a retrocession of the intercostal muscle. It is very strong indeed, and it is the chief factor in producing the approximation of the first two ribs and the consequent rotation of the manubrium around a transverse axis. It is strongest and best marked in that portion of the interspace corresponding to the thickened aponeurosis outside the external intercostals, but it extends backwards almost to the back part of the space. The action of this last ligament, for I think we may fairly regard it mechanically as such, and developmentally as retrocession from the internal intercostal muscles, is a very important factor in the production of the backward displacement of the upper fragment in dislocation and in fracture of the sternum, when present, and if fracture or dislocation of the manubrium is ever produced by flexion of the spine alone, this ligament is the chief factor in its production. On removing the external and internal intercostal muscles from the second interspace a similar plane of ligamentous fibres is seen. It lies behind the vertical level of those in the first space, and it appears to continue its direction downwards and backwards. These ligaments I shall call the *intercostal ligaments*.

In passing from the front of the cervical spine to that of the upper dorsal spine, a sudden transition in the appearance of the anterior surface of the vertebræ is observed. The front of the bodies of the upper dorsal vertebræ is frequently quite smooth, as in the spine of an individual not leading a laborious existence. The pressure of the sack with its rigid contents by

its direct action diminishes the natural curve of the upper part of the dorsal spine, rendering it almost straight. Besides this direct pressure of the load on the spine, an indirect pressure is brought to bear on it through the head, neck, and tubercle of each rib, the load resting on and about its angle. In many cases this leverage exerted by the rib on the vertebra produces some bossing of bone around the facets on the bodies of the vertebra, while in others this deposition of bone is insufficient to prevent the forward movement of the head of the rib, and in these cases the head and neck of the rib lie on a plane anterior to the normal. If a horizontal section through a well-marked instance of this displacement be examined, you find that the original interosseous costo-vertebral ligament is absent, but that a vertical interosseous ligament has taken its place, and that the opposing surfaces of vertebra and rib in front and behind it are lined by a synovial membrane. A prominent projection from the side of the vertebra serves to prevent still further forward displacement. This form of articulation is produced by the newly acquired movement, or rather by a modification of the normal movement that takes place between the rib and vertebra. This is an extreme instance of this condition; between this and the normal one finds in this group of labour changes many stages. This condition is usually best observed in the seventh or eighth ribs, but frequently all the upper costo-vertebral articulations show it in a slighter degree. As I observed before, the upper two thirds of the dorsal spine present no bossing on its anterior surface. It is, however, very much straighter than normal, and the heads of the ribs are on a plane anterior to that which they usually occupy. The depth of the fibro-cartilages is not very perceptibly diminished. The straightened portion of the dorsal spine joins the lower portion of the column in such a manner as to form with it an obtuse angle, whose size varies in different subjects. The lower portion of the column at the same time presents an increased forward convexity. The formation of the angle results from the partial destruction by compression of the bodies of the tenth, eleventh, and twelfth dorsal and of all the lumbar vertebræ. The fibro-cartilages of the lumbar spine are very much thinned, and several of these vertebræ may be fused to one another and to the sacrum. There may

or may not be any lateral deviation of the column in the lower dorsal and upper lumbar regions. This deviation, if present, is probably due to the weight not being carried directly upon the centre of the back, or to its receiving unequal support from either arm. Figs. 7 and 8 show this curvature from the front and laterally. These drawings are perhaps a little deceptive in that they suggest the appearance that the intervertebral fibro-cartilages are increased in thickness. The clear space between the horizontal dark line really represents an abundant marginal osteophytic growth which has fused with a similar growth from adjacent vertebræ, and has, in this manner, rendered the joints between the vertebræ practically fixed. By this means the sacrum, lumbar spine, and last dorsal vertebra may be so much connected to one another as to form what is practically a single bone. If we examine the lumbo-sacral articulation, as one would expect, there is a strong tendency to the forward displacement of the fifth lumbar vertebra from the upper extremity of the sacrum and the formation of a condition called spondylolisthesis. This inclination to forward displacement is not limited to the last lumbar vertebra, but is also present in the other lumbar vertebræ, but in a less degree; in fact, the tendency diminishes as you ascend the lumbar spine. It also varies considerably in degree in different subjects. We can judge of this tendency by the alterations which ensue in the form of the vertebral bodies, articular processes, and fibro-cartilages. It will also be seen that the density of the bones varies directly as the severity of the labour. With regard to the lumbo-sacral articulation, the changes produced in an early condition of these labour changes while there is as yet no permanent spondylolisthesis, consist in an alteration of the direction of the articular surfaces on the articular processes of the sacrum and fifth lumbar vertebra. They now look forwards and backwards, instead of inwards and outwards as in the normal spine. This alteration in the direction of the articular surface is to oppose forward displacement of the fifth lumbar vertebra. The depth of the intervening fibro-cartilage is also much diminished, and in some cases it splits horizontally, an articular cavity being formed. In such a column a certain amount of spondylolisthesis or forward displacement of the last lumbar may be produced by exerting

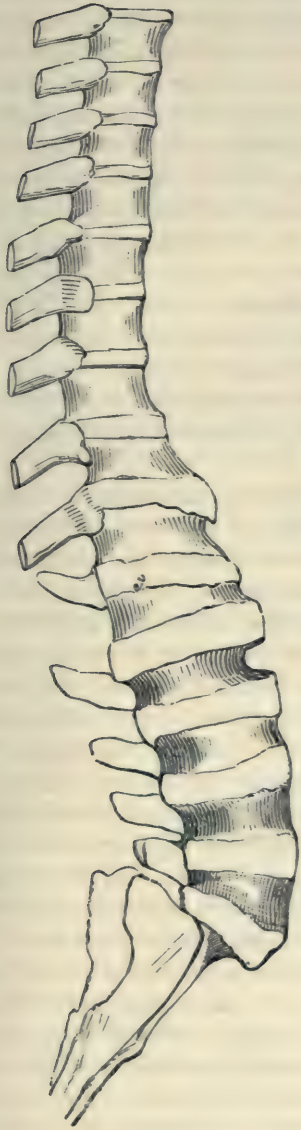


FIG. 8.

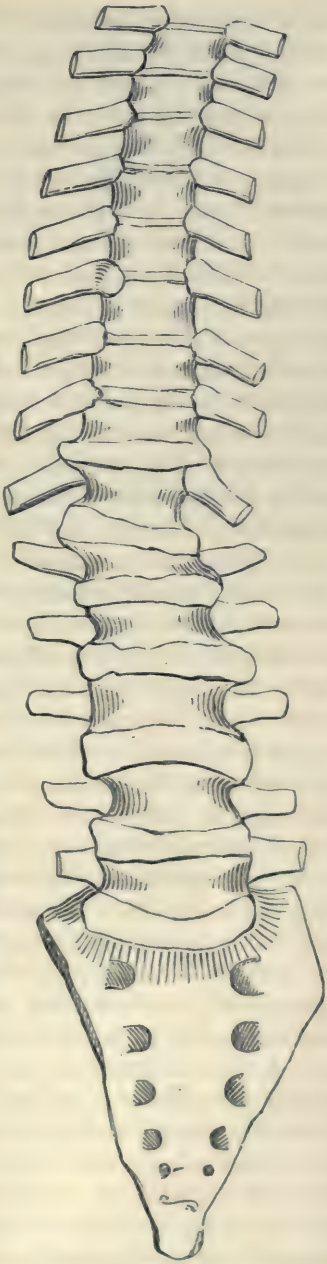


FIG. 7.

on the column such pressure as the load would exert. This deformity, however, disappears on removing this pressure. In more advanced stages the articular processes, laminæ, and fibro-cartilage yield, and the fifth lumbar becomes displaced in advance of its normal position, and the portion of the body of the lumbar vertebra that projects beyond the normal sacrum is supported below by a process of callus or bone which projects forwards from the anterior margin of the upper piece of the sacrum. Should the load carried be very heavy and no restitution movement be required in the lumbo-sacral articulation, the amount of fibro-cartilage intervening between the sacrum and lumbar vertebra becomes still more diminished in thickness, and in some cases it may be completely removed, and bony union may ensue. In these cases also the opposing surfaces become very irregular, so as to assist still further in opposing the tendency to forward displacement, by locking into one another. (See fig. 3, Plate V.)

Should a certain amount of restitution movement be required in the lumbo-sacral articulation, it is rendered arthrodial in character by the complete horizontal fission of the cartilage and the formation of a powerful fibrous capsule. (See fig. 2, Plate V.) Whether the lumbo-sacral articulation forms an arthrodial or a more limited amphiarthrodial joint, or even disappears owing to the partial or complete fusion of the opposed bones, would appear to depend on the heaviness of the load carried, as in cases in which the arthrodial joint is developed, the bones of the skeleton are decidedly less dense and strong than in those cases in which the movement in this articulation is very much limited. We shall see that the same conditions appear to be present in the sacro-iliac joint. In fact I have found it the rule in the case of the joints of the spinal column, occipito-atloid, lumbo-sacral, or sacro-iliac articulations, that a very heavy weight tends to fix the articulation on which it exerts pressure, removing all soft structures between the opposing bony surfaces, and ultimately causing their fusion. We see this exemplified by the cervical vertebræ in this form of labour curve, and also in that form produced by carrying loads on the head. On the other hand, in the case of lighter burdens, which necessitate a greater range of movement in the spinal and pelvic joints, as the labourer is, owing to their

lighter weight, able to raise them from the ground and place them in position, you find a condition the reverse of fixation, namely, a tendency to a greater freedom of movement in the joints enumerated above. When the movement in the lumbo-sacral articulation is limited, you find that that which takes place in the sacro-iliac joint is also limited; that in many cases the upper part of this joint is bridged over by bone, the separation between the two bones being obliterated or only indicated by a fine serrated suture. In some few cases I have found this joint completely fixed throughout. In these cases of fixation you find also that the symphysis permits of little or no movement, on account of the diminution in the breadth of the fibro-cartilage intervening between the bony surfaces, and the increase in depth of these opposing surfaces. In rare cases these surfaces are united by bone. When the movements in the lumbo-sacral articulation are exaggerated, these conditions are all reversed. For examples of several of these changes, see figs. 2, 3, and 4, Plate V.

If we now examine the spinous processes and laminæ of the several vertebræ, we find that the supraspinous and interspinous ligaments in the dorsal and lumbar region are enormously thickened, as are also the erector spinæ muscles. These ligaments are perhaps thickest in the lower dorsal and upper lumbar spine, where practically they support the greatest strain. In some cases bony processes extend from the tips and margins of the spinous processes into these ligaments, while in others small centres of ossification appear in the centre of the thickened ligaments. This was well shown in a specimen I described in the nineteenth volume of the 'Journal of Anatomy and Physiology,' "Supernumerary Cervico-Dorsal Vertebra Bearing Ribs, with Vertebral and Costal Asymmetry." These bony growths from adjacent vertebræ may unite with one another, and so assist in rendering this portion of the column rigid.

The spinous processes of the lower lumbar vertebræ and those of the sacrum, though extremely dense and strong, are rather under than over the average size. The reason is that in the performance of this labour they lose part of their original function, namely, that of assisting the direct transmission of weight, which is shown enormously exaggerated

and very clearly in fig. 1 in Plate V, which I have previously described, and they now merely serve as points of rigid attachment for the supra- and interspinous ligaments, and oppose extreme flexion of the column. This last, which is only part of their normal function, is enormously exaggerated.

Owing to the downward, as well as the forward and downward direction of the pressure transmitted through the lower lumbar vertebræ to the sacrum, the strong articular processes of the fourth lumbar, assisted by those of the sacrum, alter very considerably the shape of the lamina of the fifth lumbar vertebra, and in some cases they may even cut it through, so that a small portion is set free on either side. Professor Neugebauer, in his very exhaustive study of spondylolisthesis, regards this condition of the lamina as a congenital defect in its ossification and one of the primary causes of the forward displacement of the last lumbar vertebra. I believe he is wrong, and that his error arose from considering this condition purely as spondylolisthesis, and in regard to its obstetric bearing, and not comparing the changes found here with those present in the rest of the column and skeleton generally. For full details as to his opinions I would, however, refer the reader to his works, 'Zur Entwickelungsgeschichte des Spondylolisthetischen Beckens,' 'Contributions à la Pathogénie et au Diagnostic du Bassin vicié par le glissement vertébral,' par Dr. François Neugebauer de Varsovie, &c. I have given a brief abstract of his work in the thirty-sixth volume of the 'Transactions of the Pathological Society,' "Some of the Changes which are produced by Pressure in the Lower Part of the Spinal Column," from which paper I will now give the descriptions of fig. 2 and fig. 3, Plate V, which are examples of spondylolisthesis. In fig. 3 the lumbo-sacral, sacro-iliac, and pubic articulations were rendered more or less rigid, while in fig. 2 these joints were rendered very much looser than usual by the development of articular cavities in the fibro-cartilage.

Fig. 2, Plate V. The body of the third lumbar vertebra presented only slight marginal osteophytic growth. Its lower articular processes were marked with large oval facets, which looked directly forward. Those of the fourth lumbar vertebra presented the same change in a more marked degree. The body

of the fifth lumbar vertebra was diminished in depth posteriorly, where it measured three quarters of an inch, while its anterior vertical measurement was one and one eighth inches. Its lower surface was densely sclerosed. The whole of the body of the fifth lumbar vertebra was displaced forwards, so that its posterior inferior margin lay half an inch in front of the corresponding margin of the sacrum. This displacement forwards could be materially increased by pressure.

The lamina of the fifth lumbar vertebra was much modified in form by the pressure exerted on it by the articular process of the fourth lumbar vertebra and by those of the sacrum. It was thicker and denser than usual. It almost touched the posterior margin of the upper surface of the sacrum, and interfered very considerably with the calibre of the last intervertebral foramen.

This diminution in the calibre of this foramen, which we shall find present so frequently in these deformed columns, may explain many obscure cases of sciatica and of paralysis of the muscles of the leg.

The upper articular processes of the fifth lumbar vertebra were considerably increased in breadth and presented circular flat facets, whose direction was directly backwards. The lower articular processes presented flat facets, whose direction was forwards and slightly downwards.

The spinous processes of the lumbar vertebræ were not enlarged, nor did they articulate with one another or with the sacrum.

The upper surface of the sacrum was also very dense, and a compact bony lip projected forwards from its anterior margin.

The opposing surfaces of the bodies of the fifth lumbar vertebra and the sacrum were each covered by a layer of articular cartilage and synovial membrane, and they were connected by a fibrous capsule, so that an arthrodial joint had replaced the original amphiarthrodial one.

The articular processes of the sacrum were modified in a corresponding manner to those of the fifth lumbar vertebra. The ligamenta subflava were very much thickened.

The laminæ of the sacrum were not thickened, nor was the ridge produced by the fusion of the sacral spinous processes

prominent. In fact it was less marked than usual. The sacro-iliac articulations were very loose.

The *next specimen* (fig. 3, Plate V) is also a vertical section. It has, however, passed slightly to one side of the median line below. All the bones were very dense and strong. The upper articular processes of the third lumbar vertebra presented but slight change. The lower ones were much enlarged and had oval facets which were directed outwards. On exerting pressure on the spine the articular processes were seen to articulate with the lamina of the fourth lumbar vertebra. They had rendered it thin by the continual pressure.

The lower processes of the fourth lumbar vertebra were much enlarged, and were cubical in form. They presented flat square facets, which looked forwards and outwards. On the broad extremity of each articular process there was a flat facet which articulated with two movable portions of the lamina of the fifth lumbar vertebra, and also at the same time with a portion of the upper articular process of the sacrum. The fifth lumbar vertebra presented many changes. The body was considerably diminished in depth posteriorly, where it measured only three quarters of an inch. The posterior margin lay five eighths of an inch in front of the corresponding margin of the sacrum, and a thin lamina of bone projected backwards from this margin and rested on the upper surface of the sacrum. In front the body rested upon a bony shelf which projected from the anterior margin of the sacrum. The opposing surfaces of the bodies of the sacrum and fifth lumbar vertebra presented an irregular outline, which practically served to lock the bones and prevent forward displacement of the lumbar vertebra. The fibro-cartilage had been replaced by a very scanty fibrous tissue which formed a very thin layer between the bony surfaces. This firm locking of the sacro-lumbar joint accounts for the fact that the direction of the lumbar articular facets was but slightly modified. Pressure, exerted in a vertical direction through the articular processes had caused absorption of the lamina of the fifth lumbar vertebra and its division into three movable parts. A small piece, half an inch square, had been separated on either side from the articular process anteriorly and from the rest of the lamina posteriorly. These small pieces of bone lay directly above the posterior

margin of the sacrum, so that when firm pressure was applied to the spine these pieces of bone were displaced and the intervertebral foramina were obliterated. This was most marked on the right side. The fifth nerves appeared to have suffered very much from this pressure. The lower articular processes of the fifth lumbar vertebra were marked by quadrilateral flat facets which were directed outwards, forwards, and slightly downwards. The articular process of the sacrum presented corresponding changes, but besides this they articulated with the articular process of the fourth lumbar vertebra, as we have before seen. The transverse processes of the fifth lumbar vertebra articulated with the sacrum. Both sacro-iliac articulations had been bridged over by bone, and had been rendered fixed. This is another instance of the fixation of a joint under the influence of pressure, when no restitution movement is required in it.

The coccyx did not articulate with the end of the sacrum, which presented the usual oval facet, but was connected to the right margin of the sixth piece of the sacrum. It was very small.

Changes Produced in the Spinal Column by Carrying Loads on the Upper Part of the Back and on the Neck.

The form of labour change which I will now describe is frequently combined with the last, and though I have recognised it for some time in its simple form in the living subject and in its combined form in the dead body, I succeeded only recently in obtaining a typical example in the dissecting room. These labourers carry their loads on the upper part of the back and on the back of the head and neck. They usually wear the same tarpaulin cap worn by the labourers in the last group and a large number of these also wear a circular pad or "knot," which is very thick and broad where it rests on the upper part of the chest, shoulders, and neck, and much less bulky in front where it presses against the forehead. Both this structure and the hat must be very familiar to those who have observed labourers at work. As in these subjects the head and neck are affected by almost the same pressure as

they are in the class just described, the changes in these parts are much the same as those already described. There is usually much more change in the bodies of the lower cervical vertebræ, and they with the bodies of the upper six dorsal vertebræ form a slight curve. This curve joins at an obtuse angle, which varies in size in different subjects, a lower slight curve formed by the remaining dorsal and the lumbar vertebræ. It is upon this upper curve as upon a shelf that the load presses either directly or through the medium of the pad. The vertebræ which show most change are those between the third and ninth dorsal. As the bodies of these vertebræ are narrow it is necessary that they should be rendered more able to bear their burdens by receiving some support, either from a fusion of their bodies or by an abundant deposit of bone on their opposing margins, which fuses together with those from adjoining bones, over the intervening fibro-cartilage, and renders this curve rigid. On examining the spine and chest it is obvious that in the case of the dorsal spine such a condition is necessary as the diminution in the capacity of the chest would be considerable if the intervertebral substances were removed, or arthrodial joints developed in their stead. Consequently the fibro-cartilages present comparatively slight compression changes. The anterior surfaces of the bodies of the vertebræ are rendered denser than the posterior portions, and a very compact sheathing of extremely dense bone bridges over the anterior and lateral aspects of the fibro-cartilages and extends as a layer of varying thickness over the anterior surface of the bodies of the vertebræ. The amount of this bony material varies greatly in different subjects. Fig. 9 shows a portion of such a curve formed by the fourth to the ninth dorsal vertebræ in vertical median section. The function performed by the dense supporting callus in enabling the spine to support its load is so obvious in the drawing that I need not explain it further. The posterior surface of the bodies of the vertebræ and of the fibro-cartilages is quite smooth. It will be noticed that the mode in which these vertebræ are united together by bone is altogether different from any we have yet observed in labour curves, since the opposing surfaces of the vertebræ have not yet come into direct contact by the removal of the intervening fibro-

cartilage, as in the cervical spine. This would appear to be due to the fact that the sternum and ribs prevent the crumpling up of the spine in the vertical direction, the sternum serving partly as a rigid rod fixed to the vertebræ by the ribs which

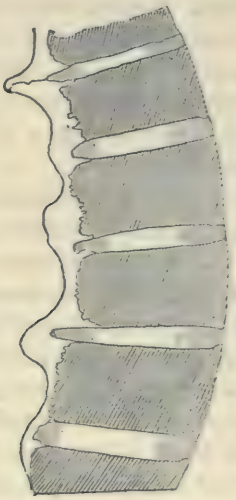


FIG. 9.

also react on the vertebræ as levers, the forces acting on them being the powerful muscles which are attached to them and which act vigorously during the performance of this labour. In the lateral curves in this region, which arise from labour or are present in an advanced condition of ordinary lateral curvature, there does not seem to be the same obstacle to the destruction of the fibro-cartilages and the occasional fusion of the opposed margins, and in such cases the sternum and ribs would not tend to obviate it in the manner described. Whether my explanation of the pathological sequence of events is correct or not, the conditions remain as I have described them. This antero-posterior curve in its functions corresponds closely with the lateral curve present in the class of labourers who carry their loads upon one or other shoulder. In the latter there is not the same possibility of fusion of the vertebræ by bony union because of the long leverage exerted by the ribs upon the vertebræ, and the movements necessary to place the load

in position. In the former the load is usually taken from a point considerably above the level of the ground, or it is placed in position by the assistance of another. The laminæ of the dorsal vertebræ corresponding to the centre of the curve are increased in depth, and the interspinous and supraspinous ligaments are very thick. Occasionally these ligaments, especially the latter, are encroached upon by the extension of bony growth from the spinous processes. As in the last form of curvature, the heads of the upper four or five ribs are forced forwards a little so that they lie in a plane anterior to that which they occupy normally.

It is much more common to meet with very marked instances of the changes in the manubrio-gladiolar articulation which I have figured in Figs. 5 and 6 in labourers of this class than it is in the last-described class, and the reason is obvious.

The changes in the lumbar spine and lumbo-sacral articulation are slight as compared to those described in the preceding class. They are, however, very similar in character. In the last joint you find a tendency to forward displacement of the lumbar vertebra, but this is slight as compared with that which we have observed when a larger and heavier weight is carried upon the whole length of the dorsal spine.

Changes in the Spinal Column arising in Youth and in Old Age, and commonly Classified as Instances of Dorsal Excurvation.

A. *The form which arises during Youth.*

With the form of dorsal curve I have just described I would compare two other dorsal curves which resemble it superficially. The first is not produced by carrying loads, and the consequent pressure changes, but it is due to a cramped or faulty position which the individual assumes from necessity or from carelessness during the performance of certain forms of labour. The changes we will examine take place during the period of youth, and generally cease to progress after adult age is reached. They are very common in a less marked degree, when the subject is said to be round shouldered, or to have a

stoop. As one is frequently called upon to treat this minor degree, it is well that we should be familiar with its pathology, and with the obstacles which oppose the removal of the deformity. These curves are usually found in subjects who are not strong, and they are rarely accompanied or complicated by the presence of pressure changes. The following is a typical instance, and as the condition is very marked, we can draw general conclusions from it.

N.B. — Up to sixteen years old was quite strong and healthy, and had never performed any hard manual labour. At sixteen he commenced work as a shive maker. This occupation necessitated his stooping considerably while he was engaged at it, and during the first fortnight he suffered severely from pain in the dorsal region, especially between his shoulders. After some weeks this pain gradually diminished, and at last disappeared. Very soon after he commenced this work his mother and friends noticed that his spine was growing out, and that he became shorter and stooped very much. Later this curvature increased so much that he became quite deformed. He continued at this occupation for four years, after which he earned his living by selling firewood. It is, therefore, apparent that at no period of his life did he perform hard manual labour. He was admitted into Guy's Hospital, under Dr. Pye-Smith, suffering from severe capillary bronchitis of which he died at the age of twenty-seven.

Post-mortem examination. — Both pleuræ were adherent throughout. The bronchial tubes were dilated and contained much pus. The spinal column presented a very marked exaggeration of the normal curve. This caused a condition of kyphosis, with much deformity of the chest. The anterior surfaces of the vertebræ forming the curve were smooth, and there was no lipping of their anterior margins nor osseous change in the anterior common ligament. The margins of the fibro-cartilages were defined and unchanged, though the cartilages were diminished in depth. A median section through the vertebræ forming the curve (see Fig. 10) also showed a condition of affairs very different from that described as existing in the last form of labour change. The bodies of the vertebræ forming the curve were so shaped, that their upper and lower surfaces, if prolonged, met in a point corresponding to the

centre of the curve. The depth of the anterior surface of each body was under the normal, and that of the posterior surface of each was in excess of the normal, and consequently largely in excess of the anterior surface. The antero-posterior

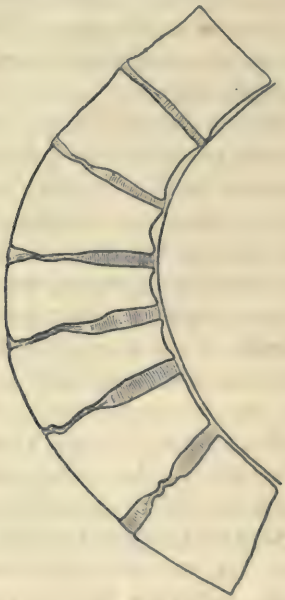


Fig. 10.

diameters of the bodies of the vertebræ forming the curve were also much increased. The texture of the bodies of the vertebræ was uniform, and of the density which one would expect to find in an adult leading an active life, but not performing hard manual labour. The laminæ and spinous processes were much increased in depth, and overlapped each other considerably, so that the lamina of the vertebra above articulated with that immediately below it by an obliquely placed flat surface nearly three quarters of an inch in depth. These opposing surfaces were united to one another by a thin layer of dense ligamentous tissue, which permitted of very slight movement between the bones. This fibrous interosseous ligament was the relics of the ligamenta subflava. The original ligament had been replaced, and the interval between the laminæ increased owing to the position of flexion of the

spine, had been covered in by the considerable and gradual increase in depth of the laminæ. This overgrowth of the laminæ and their firm connection to adjoining laminæ obviated the possibility of very sudden and severe strain being thrown on the anterior portions of the vertebral bodies forming the concavity of the arch, and in this manner they opposed the tendency to any increase in the dorsal curve, causing any vertical strain to be transmitted through that portion of the vertebræ most able to bear it, and that was the posterior portion of their bodies. This is seen by examining the condition of the fibro-cartilages. They differ in their appearances from those present in pressure changes, though the alteration in them is partly the result of pressure. Their anterior portions were diminished in depth, but were apparently normal in structure and appearance. Their posterior portions were thin and their structure was altered. The fibres no longer ran at right angles to the opposing surfaces of the vertebræ, but were arranged in a plane parallel to it, so that the thinned cartilage could be easily split into horizontal plates. The layer of bone in the immediate vicinity of this portion of the cartilage is slightly denser than elsewhere, and it is on this point as a fulcrum that the vertebræ moved on one another in the movements of flexion and extension of the spine. The lumbar curve was exaggerated, but I was unfortunately unable to obtain the whole of the column for examination. The antero-posterior median section of the dorsal curve presents a condition of vertebræ which resembles very closely in its pathology that seen in a transverse vertical section through one of the lateral curves in a case of lateral curvature. In that, however, you do not get the change in the cartilage which takes place in the antero-posterior curve, as there is not the same resistance to the increase of the curve as is offered by the spinous processes and laminæ. This very opposition to increased antero-posterior flexion of the column serves in advanced cases as a very great obstacle to the possibility of diminishing the increased curve by treatment. As is apparent from the examination of the specimen I have described, little or nothing can be done when once the individual has reached his full growth.

Now, as regards the principles upon which the treatment of this deformity must be based in less aggravated cases. They

are the direct and indirect extension of the flexed spine. The former is carried out by placing the patient on the back for varying periods of time, and also by using as adjuvants sand-bags which serve as fulcra or fixed points on which you open out the curve. The latter, and by no means the least important, consists in making use of the immense leverage that you can exert on the sternum and upper ribs by means of the clavicle, and the transmission of force backwards to the bodies and transverse processes of the upper dorsal vertebræ, resulting in their extension. The arms are placed well above the head in that position which they are made to assume when you wish to distend the chest in Sylvester's method of artificial inspiration. The clavicles by their ligamentous attachment to the sternum, the first ribs and their cartilages, raise the sternum and first costal arch, at the same time exerting great pressure on the first dorsal vertebra in the direction of the axis of the rib. Pressure is also made on the second, third, fourth, and fifth vertebræ in the direction of their axes, partly through the sternum and the costal cartilages, and partly by the traction exerted by the first ribs upon the ribs below them, through the intercostal muscles, ligament, and fasciæ. The pectoralis major and minor with the serratus magnus assist in this action to some extent.

The deformity which I will now describe resembles the last very closely in appearance. It occurs in old people, and is commonly spoken of as dorsal excurvation. As in the last case also, the change in curvature is not limited to the dorsal spine, the lumbar spine and sacrum in this case showing quite as marked changes as the remainder of the spinal column. The pathology of the senile change will be found to differ in many particulars from that which develops in young life, as the conditions of the osseous system at these opposite periods of life are so dissimilar. In the spine previously described the curve was produced gradually in the growing bones of youth, while in that which I am about to describe the bones have usually begun to degenerate, and have lost the dense compact texture of vigorous adult life by the time they commence to form exaggerated curves.

B. *The Form which arises during Old Age.*

I will now refer to a paper in the 'Transactions of the Pathological Society,' vol. xxxvii, "The Causation and Pathology of the so-called disease Rheumatoid Arthritis, with a Sequel on Senile Changes." In that I showed that in old age the individual ceases to perform movements of extreme extension and flexion, particularly the former, and that the flexor muscles are no longer opposed by the tonic and frequent contractions of the extensor muscles. In the limbs this limitation of movement results in very remarkable changes in the joints. These I described fully in that paper. The hand, for instance, is flexed, and adducted on the forearm at the wrist, the fingers flexed and adducted at the metacarpo-phalangeal articulations, and the bases of the phalanges are displaced upwards and inwards off the heads of the metacarpal bones. In the elbow-joint the movements of extreme extension and flexion are lost owing to thickening of the margins of the olecranon and coronoid processes, and to deposit of bone in the floor of the fossæ which receive these processes of the ulna. Changes of a similar nature and due to similar causes take place also in the other joints of the extremity. In the same paper I referred also to the changes in the spinal column which ensue in old age, which changes we will now examine in detail. The same loss of vigour in the action of the extensor muscles, and the consequent tendency of the body to assume the flexed position, is seen here also.

The extreme exaggeration of the normal curves in the column which now ensue all have for their purpose the transmission of the superjacent weight of the head and of the neck, upper limbs, and thorax, and still lower down also, of the abdominal viscera to the lower limbs with the least possible strain upon enfeebled and degenerated muscles. How this is done we shall see best from Fig. 11, which is a drawing of a vertical median section of the neck and trunk of a female subject, and is a fairly good instance of the condition in question. Commencing above, we see that the cervical curve is much increased, and that the intervertebral substances present marked pressure changes in their posterior portions,

where some of them have been completely destroyed. From the opposing posterior margins of several of the vertebræ there are transverse projections of osteophytic growth into

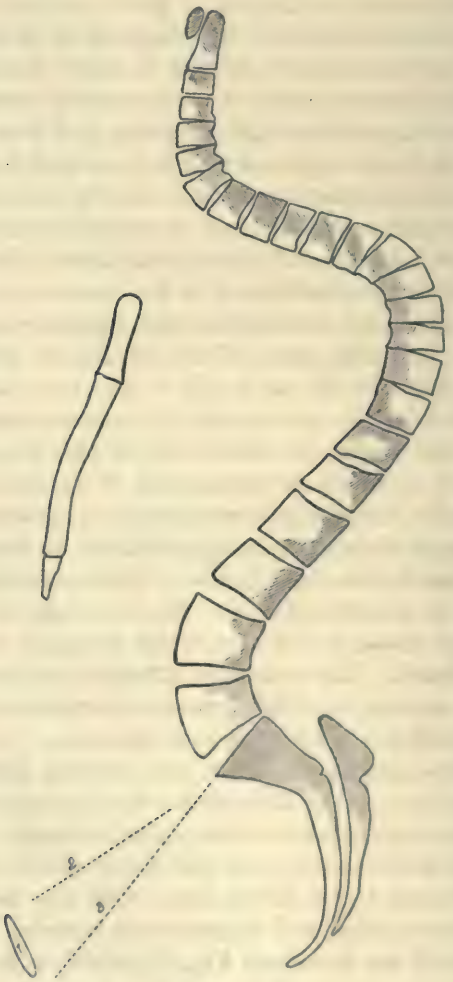


FIG. 11.

the spinal canal. The bodies of the cervical vertebræ are comparatively dense, and the bodies of these vertebræ with those of the upper dorsal are seen to be much denser than else-

where along the line of transmission of the greatest pressure. I have attempted to indicate this relative sclerosis in the diagram by the dark shading. The spinous processes of the cervical vertebræ, which I have not introduced into the diagram, are, on account of the increase in the curve in this region, resting directly upon one another. The dorsal region presents also a very great increase in its normal curve, the anterior adjoining portions of some of the vertebræ being fused together, the intervertebral substance having been previously removed from between them. The posterior portions of the fibro-cartilages as they form the convexity of the curve were subjected to no exagggerated pressure, and consequently show no pressure changes. In the exaggerated lumbar curve the conditions are reversed. The posterior portions of the fibro-cartilages are diminished in depth, the anterior portions having their thickness apparently increased above the normal. The spinous processes of the lumbar vertebræ, not shown in the drawing, were deep and thick and press directly upon one another, and upon the spinous process of the first sacral vertebra. In all well-marked cases of this senile change there is always a tendency to forward displacement of the fifth lumbar vertebra. This but rarely takes place. What usually happens instead is shown remarkably well in Fig. 12. The sacrum yields fairly

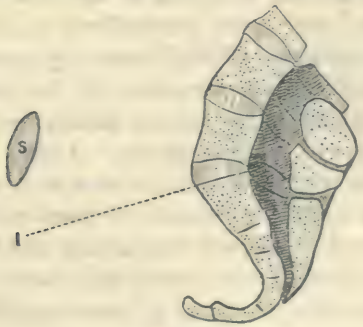


Fig. 12.

uniformly round a transverse axis, so that the appearance and symptoms of spondylolisthesis are given without any displacement of the fifth lumbar vertebra forward from the upper surface of the sacrum being present. In this diagram s indicates

the symphysis pubis in vertical section, and the dotted line 1 the direction of the plane of the facet on the upper surface of the sacrum. This line is seen to pass some way below the level of the symphysis. In Fig. 11 the sacrum has yielded abruptly at the junction of its first two pieces. The line prolonging the direction of the upper surface of the sacrum, instead of passing about one and a half or two inches above the upper border of the symphysis, passes about an inch below it.[1] It is indicated in the drawing by the dotted line 3, the direction of the brim of the true pelvis being represented by the line marked 2. The spine and lamina of the sacrum are seen to be well developed.

Forward displacement of the body of the fifth lumbar vertebra, or spondylolisthesis, does sometimes occur instead of the yielding of the sacrum. I described a very well-marked instance of it in the 'Transactions of the Pathological Society,' 1884, page 263. "Ununited Fractures of Transverse and Spinous Process of Dorsal Vertebræ and of the Ribs." In some subjects, owing to the pressure exerted upon the sacrum and coccyx by the seat in the sedentary position, the antero-posterior sacral curve is still further increased. This I have shown in Fig. 12.

In considering the pelvis in vertical median section, it is necessary to distinguish carefully between the results of pressure and conditions due to fusion of the fifth lumbar vertebra with the sacrum,[2] and more particularly to disassociation of the first sacral vertebra, which I have represented in Fig. 13. In this last condition the direction of the plane of the facet on the upper surface of the sacrum passes between the upper and lower borders of the symphysis. I have observed many instances of this condition and find that it is very much more common than is usually supposed. I have alluded to it more fully in papers in the 'Journal of Anatomy and Physiology' and elsewhere,[1 3] to which I would refer the reader for full details.

I may just state that the want of knowledge of the influence of

[1] For fuller details upon this subject I would refer the reader to a paper in the 'Journal of Anatomy and Physiology,' 1886, "Variations in the Human Skeleton."

[2] I have represented this condition of fusion of the sacrum and the fifth lumbar vertebra in a diagram in the 'Trans. Path. Soc.,' 1886.

[3] 'Trans. Path. Soc.,' 1886, "Causation and Pathology of the so-called disease Rheumatoid Arthritis and of Senile Changes."

pressure upon the sacrum during vigorous adult life and during old age, accounts for the frequent variations and consequent inaccuracies in the detail of diagrams indicating vertical antero-posterior sections of the pelvis in obstetric and anatomical works.

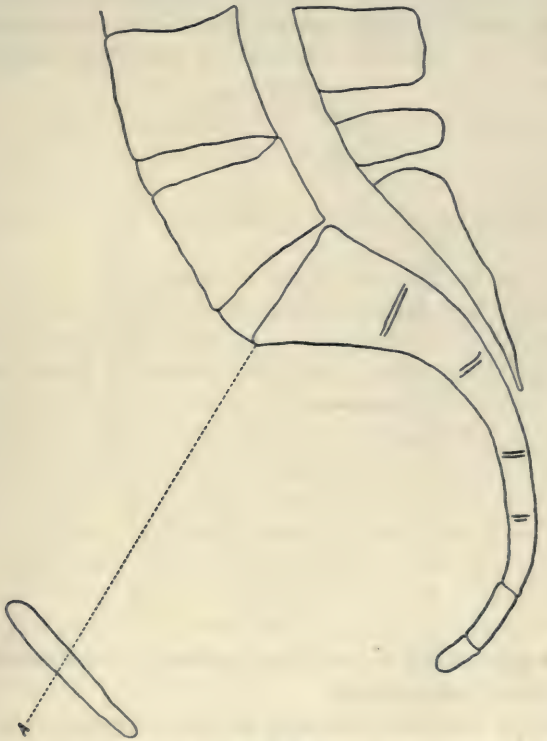


Fig. 13.

Another point of very considerable interest in this deformity of the body, which so frequently ensues in feeble old age, is a great alteration in the form of the chest. Take, for instance, the specimen we have just been examining. In Fig. 11 the upper margin of the manubrium is on the same horizontal plane as the body of the eighth dorsal vertebra, while the tip of the xiphoid cartilage, which is a short bone in this case, is on a level with the centre of the body of the fourth dorsal vertebra. In sawing the body I was very careful to retain the parts in their relative position to one another. The

ribs from the second to the seventh were closely approximated to one another, and their angles formed a prominence projecting backwards on either side of the spinal column. These ribs were flattened laterally, probably by the continued pressure of the arm, the arm being always held somewhat forcibly in the adducted position in extreme old age. This position is tolerably familiar to us. Fig. 14 represents a transverse section of the



Fig. 14.

thorax immediately below the attachment of the second costal cartilages to the sternum.

Owing to the great obliquity in the direction of the first rib the clavicles no longer rested upon it but upon the first cartilage, and instead of the clavicle being directed backwards and outwards, its direction was almost directly outwards. In consequence of this the shoulders and scapulæ were thrown much in front of their normal position, and the inner margin of the scapula was separated from the line of the spinous processes by a very considerably increased interval. The direction of the glenoid cavity was much altered, but this I have alluded to more fully in my paper on "Variations in the Human Skeleton," and the head of the humerus was altered in form, and had left its original position. This I have figured and described in detail in the 'Trans. Path. Soc.,' 1886.

Of course the relative position of the intrathoracic and abdominal viscera to the bony framework deviated very considerably from the normal. This is not only true of the relation of these structures to the ribs and sternum, but also of the relation borne by the intra-abdominal viscera, large arteries, and veins to their normal vertebral levels of vigorous adult life.

Changes in the Spinal Column, &c., due to Pressure exerted in the Body itself.

A. *Changes due to contraction of the Sterno-Mastoid.*

We will now turn to pressure changes produced by the action of a force existing in the body itself, and as examples of these we will take the deformities resulting from a conversion of the contracted sterno-mastoid into fibrous tissue, and that ensuing as the result of obliteration of the pleural cavity on one side from an old-standing empyema. In both these instances the resulting deformity may be regarded as compensatory and beneficial to the individual affected; in the first the object of the resulting change is to allow of a greater freedom of movement, and in the second to increase the respiratory capacity of the opposite half of the thorax. I have seen two instances of deformity ensuing from contraction of the sterno-mastoid, in both of which the muscle was reduced to a fibrous cord. I will describe the changes I observed in that subject in which they were best marked.[1] She was a woman, sixty years old. Examining her body before dissection, the change in the form of her chest resembled that seen in the ordinary form of lateral curvature in which the dorsal spine forms a convexity to the right. The left sterno-mastoid was represented by a fibrous band, its posterior margin appearing as a thin membrane. There was no muscular substance present in it. There was no asymmetry of the face or of the clavicle. The neck appeared to be very short. The face could be directed forwards. When this forward movement was made, rotation did not appear to take place between the axis and atlas, but low down in the cervical region. The

[1] "Case of Contracted Sterno-Mastoid," 'Trans. Path. Soc.,' 1884.

appearance was that presented by the same movement being attempted in a case of atlo-axoid disease. On exposing the spinal column, a large curve with its convexity to the right was seen to occupy the lower cervical and all the dorsal region. The normal dorsal curve was much increased. There was no compensatory lumbar curve to the left, nor was there any compensatory lordosis. The upper three cervical vertebræ were quite normal. The fibro-cartilages between the bodies of the fourth and fifth cervical vertebræ were wedge-shaped, the apex of the wedge being to the left, and over this thin margin of fibro-cartilage the adjoining and opposing margins of the fourth and fifth vertebræ had fused. The bodies of the fifth and sixth vertebræ had been joined by bone in a similar manner and to a greater extent. Their articular processes and laminæ on the left side had also united with one another, so as to form one single lamina. The body of the seventh cervical vertebra was much diminished in depth, and projecting anteriorly and laterally from its margins were prominent ledges of bone. The adjoining vertebræ presented similar osteophytic growths from their opposing margins. That portion of the anterior common ligament which had connected the body of the seventh cervical to the bodies of the sixth cervical and first dorsal vertebræ had completely disappeared, but lying on the anterior surface of the seventh cervical and upon the vertebra above and below it, was a loose synovial membrane, which lay just behind the œsophagus. The fibro-cartilages above and below the seventh cervical vertebra had been divided completely in two, so that these articulations were rendered completely arthrodial in character, approaching the condition seen generally in the reptilian spine. The synovial cavity already described communicated directly with these articulations, whence it had evidently extended.

There was much bossing of the left margins of the vertebræ forming the curve, and many of the bodies were more or less completely ankylosed to one another. These were the sixth, seventh, eighth, ninth, tenth, and eleventh dorsal vertebræ. The large single curve, and the diminution in thickness of several of the vertebræ and their intervening cartilages, compensated to a great extent for the shortening of the sterno-mastoid. In that portion of the curve where rotation took

place, there was the necessary formation of an arthrodial joint. On account of the complete absence of facial asymmetry, it is probable that in this case the affection of the sterno-mastoid did not appear during growing life, but during adult life. In the second case I dissected, the condition present closely resembled that which I have just described. When the contraction takes place during early life it is very probable that you would get a compensatory curve in the lumbar region. I have seen such a one clinically, but I have not yet had an opportunity of dissecting a case. The cause of the change in form of the clavicle in these cases is apparent, but the undeveloped condition of the lower jaw and face is less easily explained.

B. *Changes due to contraction of the Pleural Cavity in an old Empyema.*

In a chest in which one side is contracted during childhood from the presence of an old discharging empyema, the ribs on that side are closely approximated, there is a large curve of the upper dorsal vertebræ to the opposite side, the bodies being rotated round a vertical axis, so that the convexity formed by the bodies which constitute the curve is much greater than that formed by their spinous processes. On making a vertical transverse section through the bodies of the vertebræ, the changes are seen to be exactly similar to those described in the antero-posterior curve resulting from a cramped position in labour, and that description of a vertical median section will describe accurately the condition present in the bodies of the vertebræ in this case. There is no marginal bossing nor fusion of adjoining vertebral margins.

Besides the rotation of the vertebræ around a vertical axis, owing to the close approximation of the ribs of the affected side, there is also a rotation of the vertebral column around an antero-posterior axis. Owing to the rotation of the vertebræ around an antero-posterior axis the ribs of the healthy side radiate from the transverse process forming the convexity of the curve, being consequently separated from one another by an interval which is larger than usual. At the same time owing to the rotation of the vertebræ around a vertical axis, the ribs are directed much more posteriorly than is normally the case.

Should the empyema arise during early life, you find after a long interval that the dorsal curve affects fewer vertebræ than when it occurs during early adult life, also that a compensatory lower lumbar curve to the opposite side may subsequently develop. The comparative frequency with which one sees this deformed chest appeals very strongly to a more radical means of *primary treatment* of the disease, such as that I suggested and described in the 'Guy's Hospital Reports.'[1]

Besides the changes produced in the bodies of the vertebræ, there are also marked changes in the relations of the lamina, transverse and spinous processes, to one another. In some cases the resulting asymmetry of the various portions of the vertebræ is very marked.

Changes produced in the Skeleton of the Trunk by alterations in the length of one of the Lower Extremities.

We will examine first the changes produced in the skeleton of the trunk by an increase in the length of one leg over the other, and then those which result from a decrease in its length. We shall see that the changes due to an increase in the length of the limb are productive of less deformity, and are less deleterious than those which are caused by a decrease in its length. The case I will take to display the former changes is that of an old woman whose body was dissected in the dissecting room of Guy's Hospital. It was evident that during active adult life she had sustained a severe fracture of the upper extremity of the left femur. This accident left her with a limb considerably shorter than its fellow.

To obviate this deformity, she had worn a boot with a thick sole, and, as is so often the case in this form of shortening as well as in shortening due to hip-disease, &c., the diminution in the length of the limb was more than compensated for by the thickness of the cork sole.

[1] "Treatment of Empyema in Children by Resection of Rib," 'Guy's Hospital Reports,' 1882; "Treatment of Empyema," 'Manual of Operative Surgery,' 1886.

The femur had been fractured through the base of the neck, and there had evidently been considerable splintering of the upper extremity of the shaft and of the great trochanter. The head and neck had been displaced downwards, and formed a right angle with the shaft. There was an abundant callus surrounding the seat of fracture, especially in front, and from this aspect a large plate of bone extended directly upwards. This ended in a quadrilateral flat surface, which measured about an inch transversely and about half an inch in breadth. It articulated with a corresponding depression in the innominate bone, below the anterior inferior spine, which was itself encroached on by the facet.

The opposing surfaces of these bones were connected by an intervening layer of dense fibro-cartilaginous tissue, and this acquired amphiarthrodial joint was surrounded by a very strong fibrous capsule. The purpose of the abundant callus, and the formation of this joint, was partly to bind together comminuted fragments, but chiefly to afford a means of transmitting much of the superjacent body weight which could be but imperfectly transmitted through the displaced head of the femur, while at the same time, owing to a slight posterior displacement of the head of the femur, the direction of the line of transmission of the body weight was altered but very slightly from the normal. If we now add to the boot of this foot a sole whose thickness more than compensates for the disparity in the length of the leg, we have a limb which, during active vigorous adult life, has been suddenly rendered longer than its fellow, and in which the lines of transmission of pressure do not deviate materially in direction from the normal. (I mention this last circumstance particularly, as the changes seen in this class of cases differ widely from those observed in shortening of the limb in hip-joint disease, where the head has been displaced from its socket.) The acetabulum was slightly increased in depth by a deposit of bone along its upper margin, the object of which was to oppose the increased tendency to upward displacement of the head of the femur. The gluteus medius and minimus had undergone extensive fatty change.

The *pelvis* was rotated round an antero-posterior axis, so that the innominate bone on this side was about three quarters

of an inch or more above the level of its fellow. The pelvis was, however, fairly symmetrical. The left sacro-iliac synchondrosis presented along its upper margin a bony ridge formed by osteophytic growth, and crossing this bony elevation, in the position of the normal articulation, a fine irregular suture was seen. The fibrous tissue and fibro-cartilage intervening between the upper part of the ilium and sacrum had been removed by the increased pressure thrown on this portion of the articulation, and the marginal bony growth was the result of the same pressure.

The *spinal column* presented a double lateral curve, which was evidently due to the rotation of the pelvis. The convexity of the lower curve was directed to the right, the centre of the curve corresponding to the second lumbar vertebra, while the convexity of the upper curve was directed to the left. The centre of this second curve corresponded to the bodies of the second and third dorsal vertebræ. The lumbar convexity was slightly diminished. The fibro-cartilages along the concavity of the lumbar curve presented compression changes, as did the margins of the bodies of the vertebræ. The last fibro-cartilage was but slightly altered in form, and the direction of the articular surfaces on the articular processes of the last lumbar vertebra and sacrum was lateral.

The bony framework of the chest presented the change in form due to the left lateral curve.

If the shortening had been exactly compensated for by the thickness of the added sole, the spinal and thoracic deformity would have been obviated.

The case I will now take to display the changes which ensue in the trunk when one leg is shorter than the other is that of a feeble old woman whose body was dissected in the dissecting room of Guy's Hospital.

She had evidently received an injury to her right hip, probably during vigorous adult life. This injury had been followed by a gradual diminution in the length of the right leg, and at a later period by very considerable and increasing deformity of the trunk. I have seen several clinical instances of this condition, which is described in some surgical works as rheumatoid arthritis due to or set up by the injury, or in others as interstitial absorption of the neck of the femur. I have given

a detailed account of the pathology of this condition in my paper[1] in the 'Transactions of the Pathological Society,' 1886, in which I have made use of this specimen to help to prove my hypothesis, viz. that most, if not all, those conditions described under the vague term of rheumatoid arthritis are nothing but the expression of pressure changes. I have also illustrated the conditions present in this specimen by two diagrams.

In this subject there was no sign of the presence of the so-called rheumatoid arthritis as affecting any of the joints of the extremities, except the right hip-joint.

The right leg was about an inch shorter than the left, as measured from the anterior superior spine to the external malleolus. This did not represent the apparent shortening, due to the alteration in the position of the pelvis and the deformity of the trunk.

The *head and neck of the right femur* presented remarkable changes. On examining them superficially, the direction of the neck appeared to be considerably altered, as if it had been rendered much more horizontal than its fellow. Projecting inwards from the lower and inner part of the head was a shelf of bone which articulated with the bone internal to the acetabulum, where a corresponding depression was present. The upper part of the head was flattened so as to form a tolerably plane surface which looked directly upwards. This surface of bone was very dense and eburnated. On making a vertical transverse section of the head, neck, and upper portion of the shaft, it was seen that the neck had not altered in direction and that the angle it formed with the shaft was exactly the same as that formed by the neck and shaft on the left side. The upper portion of the head had disappeared, and it was this, together with the deposit of bone on the inner aspect of the head, which gave the appearance of diminished obliquity to the neck. The lower portion of the head could be easily defined as its margin was quite distinct, and the osteophytic growth projecting from it internally was readily distinguished from the outline of the head in structure and appearance.

[1] "The Causation and Pathology of the so-called disease Rheumatoid Arthritis and of Senile Changes."

The *acetabulum* was rendered deeper and more extensive than normal, especially internally, where its margin had been much encroached upon and destroyed. The cartilage lining the cavity had been almost entirely removed and the bone forming the cavity was dense.

From a careful examination of the joint, it was apparent that as the process of attrition destroyed the opposing surface of the head of the femur and acetabulum, the shortening of the limb caused the head of the femur to become gradually displaced inwards, a new cavity, or rather an extension inwards of the original acetabular cavity being formed for its reception. This inward displacement progressed at the same time as the gradual increase in the destruction of the opposing surfaces of bone. A little consideration will afford an explanation of the cause of the changes that have taken place, and will also show that *the inward displacement of the head and the very considerable deformity of the trunk might have been completely obviated by supplying the patient with a thick sole at an early period, namely, as soon as the process of destruction, as indicated by shortening of the limb, became apparent.* We will now examine the effect produced by the changes in this joint upon the skeleton of the trunk.

The *pelvis* was rotated around an antero-posterior as well as a transverse axis. The right anterior superior spinous process was on a lower level than the left, and the lumbar convexity was enormously increased. The spinal column presented a long single curve, with its convexity directed forwards, the lumbar and upper sacral portions of the column formed its lowest part, while the remainder of the curve was formed by nearly the whole of the dorsal spine, whose normal posterior convexity was completely reversed. The upper part of the dorsal spine with the lower cervical vertebræ were in the same vertical transverse plane. Besides this large single antero-posterior curve, the spine within the same limits formed a large lateral curve, whose convexity was directed to the right, but the amount of lateral convexity was very much less than the amount of anterior convexity. All the spinal changes present were compensation changes; by that I mean changes resulting from the tilting of the pelvis, no primary pressure changes being present.

The deformity of the chest was extreme, owing to the retroversion of the dorsal curve, and to the formation of the lateral curve.

On making a vertical median section of the sacrum and spinal column, the bodies of the third, fourth, and fifth lumbar vertebræ with their laminæ and spinous processes were found to be fused to one another and to the first piece of the sacrum. The bodies of these vertebræ were compressed into very small bulk, and the intervertebral foramina were closely approximated to one another, but their calibre, though very much encroached upon, was still sufficiently patent to allow of the passage of the lumbar nerves.

The fibro-cartilage between the second and third lumbar vertebræ was partly destroyed by the pressure, and its lamina and spinous process were fused to the vertebra immediately below. The sacro-vertebral angle had been completely altered by the changes in this region, the lower part of the lumbar curve forming an angle of 120° with the anterior surface of the sacrum.

Returning to the *pelvis*, the brim was rendered slightly oblique owing to the increased pressure thrown upon the right side. The margins of the sacral and innominate bones forming the right sacro-iliac synchondrosis were everted and thickened by the deposit of bone on them. They were connected in front and superiorly by a loose layer of ligamentous tissue, and the joint allowed of very free movement. On cutting through the ligaments which covered the articulation above and in front, the opposing surfaces of the sacrum and ilium were seen to be quite unconnected to one another, and in great part deprived of any remnant of the fibro-cartilaginous tissue which originally intervened and connected these opposing surfaces. This had disappeared under the influence of the exaggerated pressure, which had also produced the lipping and eversion of the margins of the articular surfaces.

The fibro-cartilage intervening between the pubic bones had apparently been much compressed, and this, together with the change in the right sacro-iliac synchondrosis, accounted for the slight obliquity of the pelvic brim.

The amount of destruction of the lower lumbar vertebræ and sacrum can be judged of by the fact that the line con-

tinuing forwards the plane of the upper surface of the third lumbar vertebra, passed an inch below the lower margin of the symphysis. The conjugate of the brim, measuring from the upper margin of the symphysis to what appeared to be the position of the upper extremity of the sacrum, was four and three quarter inches, while the measurement from the symphysis to the second lumbar vertebra was only four inches.

A Case of Partial Mollities showing well-marked Pressure Changes.

Before leaving the consideration of pressure changes in the skeleton of the trunk, I will describe briefly a remarkable case of partial mollities that came under my observation. For full details I would refer the reader to a paper in the 'Trans. Path. Soc.,' 1884, "Partial Mollities and Charcot's Disease," in which I made use of this case to attempt to prove the identity of rheumatoid arthritis and Charcot's disease.



Fig. 15.

Fig. 15 is a drawing of the specimen, the pelvis and lower three lumbar vertebræ, and fig. 4, Plate V, represents it in

vertical median section. The fifth lumbar vertebra and the innominate bones alone appear to have been affected by a local mollities, and the first especially has yielded to pressure. As the result of the superjacent weight its body has projected in front of the plane of the anterior surface of the sacrum and lumbar spine, producing a condition which might fairly be described as spondylolisthesis, since a portion of the body of the fifth lumbar vertebra has been displaced forwards from the facet on the sacrum. A portion of the body has also been displaced backwards, and has carried with it the fourth lumbar vertebra and superjacent spine. This backward displacement has diminished very materially the calibre of the spinal canal at this level. The lamina and articular process of the fifth lumbar vertebra on both sides, but especially on the right side, have become fused to the corresponding parts of the sacrum, and the calibre of the intervertebral foramen on the right side has been nearly completely obliterated. The fifth lumbar vertebra was dense and white and resembled mortar in appearance. The innominate bones presented the same appearance. In this case we see the influence of the transmission of pressure upon diseased bones, and for some reason which is not quite obvious it would appear that there was a tendency to displacement backwards rather than forwards of the fourth lumbar vertebra. The shortening of the left leg produced by the yielding of the left innominate bone ought to have increased very materially the tendency to form displacements of the fourth and fifth lumbar vertebræ which would be natural in a very feeble subject. The only explanation I can offer is that the shortening of this limb was more than compensated for by an added sole. As we have already seen, this would cause the change in the direction of the line of transmission of superjacent weight. I was unable to come to a more definite conclusion as to the causation, as only this portion of the body came into my possession.

Some Points in the Physiology and Pathology of the Thorax and Shoulder Girdle.

Before proceeding to the consideration of the connections of the shoulder girdle with the thorax, or of the pathology of that connection, I would first call attention to some points referring to the skeleton of the thorax.

Form of Chest in both Sexes.

If we examine a large number of bodies, both male and female, we find that the form of the chest follows certain definite rules. If its upper part is relatively large, its lower part is relatively small and *vice versâ*. We can gauge the capacity of the different portions of the chest by measuring the spans and lengths of the ribs and the lengths of the manubrium and gladiolus.

If the upper part of the chest is relatively large, we find that the span of the first rib is above the average, that the manubrium is relatively long as compared with the gladiolus, and consequently that the upper intercostal spaces are broader than they usually are. We also find that the gladiolus is shorter than usual, that the lower costal cartilages pass up very obliquely to the manubrium, and that the number of cartilages articulating with the gladiolus may be diminished, the seventh cartilage frequently articulating with its fellow across the front of the xiphoid cartilage, and the eleventh and twelfth ribs are very short.

Observing such a chest, it is plain that its upper portion would move much more than does the upper portion of what might be regarded as an average type of chest during the inspiratory act.

The reverse is true of a chest in which the lower portion is exaggerated at the expense of the upper. In such a case the spans of the upper ribs and the length of the manubrium are less than normal, consequently the breadth of the upper intercostal spaces is below the average. The gladiolus is more than usually long, and the lower true cartilages join the sternum at

a less oblique angle than in the average chest. There is also a tendency for an eighth costal cartilage to articulate with the sternum on one or both sides. The lower two ribs are longer than usual.

The last point is of very considerable importance, especially with regard to operative interference with the kidney from the loin; for, as I have shown elsewhere,[1] the downward extension of the lower limit of the pleura varies directly as the length of the last ribs, which means practically that it depends on the form of the chest.

Observing such a chest one sees plainly that during the process of respiration the lower portion of the bony framework moves much more in the inspiratory act than does the lower portion of a chest in which there is not the same relative exaggeration of its lower part. The truth of these conclusions which I have arrived at in this manner can be verified by taking typical specimens of these forms of chests in the living subject.

It will then be found that though many men possess an exaggerated upper chest, the character of whose respiration can be best designated by the term superior costal respiration, this type belongs especially to the female sex. The same fact—I mean the marked exaggerated movement of the upper portion of the female chest—has been frequently described and figured, and the term *superior costal* has been used to describe the character of the respiration; but I do not think that the cause or reason of this peculiarity has ever been explained.

This type of chest may then be regarded as belonging especially to the female sex. With the increased breadth of the iliac crests, the relatively diminished lower chest gives the peculiar form possessed by woman.

The excessive movement of the upper part of the chest is also exaggerated by the presence of the breast in that sex.

But though this form of chest is the usual type met with in that sex, it is by no means uncommon to find a chest the very reverse in character and resembling the form regarded as the normal in the male sex. *This relative exaggeration of the*

[1] 'Journal of Anatomy and Physiology, 1886, "Some Variations in the Human Skeleton," and 'Manual of Operative Surgery,' "Lumbar Nephrectomy."

upper portion of the female chest, and the relative diminution of its lower portion, are evidently the result of a developmental process extending over long periods of time, being a provision by nature to afford larger breathing space above when the lower portion of the chest and its breathing capacity are hampered by the presence of a fœtus in the abdominal cavity.

Occasionally the last lumbar vertebra becomes fused to the sacrum, and the shape and diameters of the pelvis are consequently altered. This condition is not an uncommon one in the gorilla and orang-utan. For fuller details on this subject, I would refer the reader to papers in the 'Journal of Anatomy and Physiology,' "Some Variations in the Human Skeleton," and in the 'Transactions of the Pathological Society,' 1886. In this last paper I have discussed the probable causation of this condition and the succeeding one.

Referring now to what may be regarded as the male type, namely, the exaggerated lower chest, we find occasionally a condition of pelvis the reverse of that just described, namely, a dissociation of the first piece of the sacrum which takes on the character of a fifth lumbar vertebra. I have already referred to this condition in this paper and have delineated it in Fig. 13. It has been regarded as an uncommon deviation from the normal, but this is certainly not my experience; I think that it is very frequently overlooked for the reason that unless a vertical median section of the lumbo-sacral articulation be made, this joint presents, on superficial examination alone, no very marked distinguishing appearance which can be regarded as characteristic. As I have already shown, the direction of the plane of the upper surface of the first piece of the sacrum, indicates at once the presence of dissociation, if one excludes the possibility of its being produced by pressure. It is also usual to divide the lumbar spine transversely during dissection, so that unless by some accident attention is drawn to the number of the vertebræ, or unless the dissociated vertebra has enlarged transverse processes or is partly fused to the sacrum, the circumstance escapes attention, and it is on this account that the condition has been regarded as rare. Since I first observed this peculiarity in the direction of the plane of the upper surface of the sacrum, I have found a great many instances of this dissociation, and they have always been

limited to the male sex. The reason of this is obvious when we see the diminution in the pelvic diameters which it entails. The conjugate diameter of the brim is much diminished.

This condition is the reverse of the process of fusion of the sacrum to the last lumbar vertebra which is so common in the higher apes.

I will now refer to one or two conditions which I have observed to be occasionally associated with extreme instances of either type of chest.

In the form first described, namely, in that *in which the capacity of the upper portion of chest is much exaggerated in relative size, a cervical rib is occasionally present.*

I have described many examples of this abnormality which I have found in the dissecting room and elsewhere, and, as it affords a good illustration of the points I have stated, I will refer briefly to one which I described in the last volume of the 'Guy's Hospital Reports,' "Cervical and Bicipital Ribs in Man."

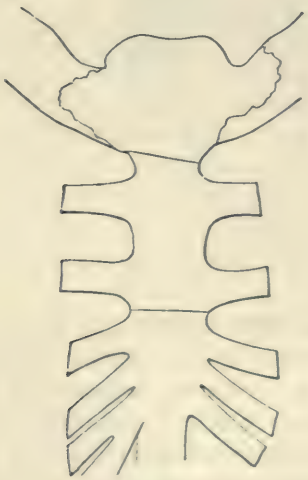


FIG. 16.

Fig. 16 represents the sternum, first ribs, and cartilages. The first thoracic ribs were very massive, and had the usual obliquity and direction of these ribs. The measurement of the right rib along its convex margin was 8 inches and along

its concave inner margin 5 inches, while the measurements of the left were $7\frac{3}{4}$, and $4\frac{3}{8}$ inches respectively. The outer span of each was about $3\frac{3}{4}$ inches. The first costal cartilages were $1\frac{1}{4}$ inches broad, the greatest breadth of the rib being $1\frac{1}{4}$ inches. In the substance of each cartilage, running parallel with the oblique outer margin of the manubrium, there was an almost complete arthrodial joint. The lateral surface of the manubrium was covered by a layer of cartilage about an eighth of an inch in thickness. The joint was surrounded by a dense fibrous capsule. There were two

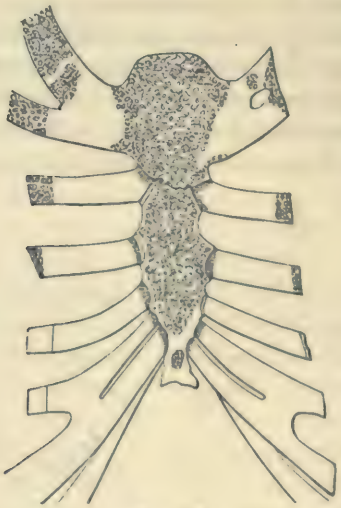


Fig. 17.

cervical ribs, the right one being movable, the left one fixed. The right one was $1\frac{1}{2}$ inches long, and articulated by its head with a prominent tubercle in the centre of the body of the seventh cervical vertebra, being united to it by an intervening layer of fibro-cartilage and by a fibrous capsule. The tubercle articulated with the enlarged transverse process of the seventh cervical vertebra. The rib ended among the scalene muscles. On the left side the cervical rib presented only a head and neck. The head was fixed internally to a tubercle which resembled that on the right side. The vertebral formula was normal, as also was the number of

the thoracic ribs. The right seventh costal cartilage was fused to the sixth cartilage outside its attachment to the sternum, and the left seventh cartilage terminated two inches from the sternum. The twelfth ribs were only one and three quarter inches long. The manubrium was three inches long, the gladiolus four inches, and the xiphoid cartilage one inch and three quarters long.

Fig. 17, which is an instance of cervical ribs fusing with the cartilages of the first thoracic ribs, also illustrates many of these points.

The manubrium measured two and a quarter inches in length, the gladiolus two and three quarter inches, and the xiphoid cartilage one and a quarter inches. Six thoracic costal cartilages articulated with the sternum on either side.

Male Type of Chest.

In the second type, or male type, in which the relative capacity of the lower part of the chest is exaggerated, you occasionally see *a very considerable diminution in the capacity of the upper part of the chest, fusion of the first and second costal cartilages or of the ribs and cartilages on one or both sides, and the presence of lumbar ribs. In some cases there is the greatest irregularity in the upper ribs, both in their spans and in the level of their attachments to the sternum, although there may not be any fusion of the upper two cartilages, and this is sometimes accompanied by marked asymmetry of the spinal column.*

Figs. 18 and 19, which were also contained in my paper on "Cervical and Bicipital Ribs," illustrate very well the first portion of this statement.

Fig. 18 represents a vertical transverse section of the sternum and costal cartilages. The manubrium was one and three quarter inches long and the gladiolus four inches and three eighths. The left first and second thoracic cartilages were fused together, and on the right side eight costal cartilages articulated with the sternum.

Fig. 19 represents an instance of partial fusion of the right first and second cartilages. The manubrium was fused to the

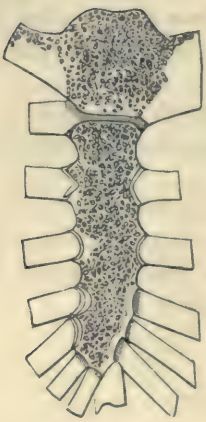


Fig. 18.

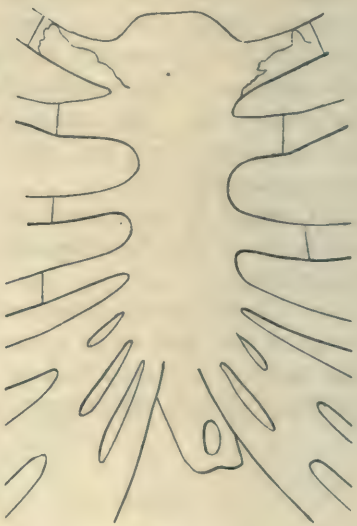


Fig. 19.

gladiolus. Its length was under two inches. The gladiolus was over four inches in length. Eight costal cartilages articulated with the sternum on the right side. For fuller details about these and similar cases I would refer to the paper on "Cervical and Bicipital Ribs in Man." The diagrams and the above short description serve to demonstrate some points in the general law I have just stated.

As regards the second portion of my statement, namely, that in chests which are much exaggerated in their lower part, there is sometimes present the greatest irregularity in the upper ribs, both in their spans and in the level of the attachments of their cartilages to the sternum, without any fusion of the upper two cartilages, being often accompanied by a certain asymmetry of the spinal column. This condition is by no means uncommon, and with it there are usually present lumbar ribs and dissociation of the first sacral vertebra.

To illustrate this I will give the following instance. It is described in detail in a paper[1] in the 'Journal of Anatomy and Physiology,' 1885.

At the time I wrote that paper I was unaware of the verte-

[1] "Supernumerary Cervico-dorsal Vertebra-bearing Ribs," &c.

bral and thoracic changes which are associated with this condition of dissociated first sacral vertebra, but I have since dissected many instances of this deviation from the normal, all of which have been male subjects. This case was a male subject. Seven cervical vertebræ were present. There were thirteen vertebræ bearing ribs, five lumbar vertebræ, and five sacral vertebræ. The first rib on the right side resembled exactly the usual cervical rib. It was movable and extended forwards from its tubercle for three quarters of an inch. Its head articulated with a prominence on the side of the first dorsal vertebra. A dense fibrous band extended from its extremity to the upper margin of the rib below it. The right second rib resembled in every particular a normal first rib. Its greatest span was three inches and seven eighths, and its greatest breadth one inch. The thirteenth rib on the right side or the first lumbar rib was four and a half inches long. The first rib on the left side articulated with the side of the body of the first dorsal vertebra, and with its transverse process. The greatest span of this rib was three inches, and its greatest breadth five eighths of an inch. Its cartilage resembled the normal first cartilage and articulated with the sternum on the same level as the cartilage of the right second rib. The left second rib and cartilage were normal in character and articulated with the sternum at the junction of the manubrium and gladiolus one third of an inch higher than the cartilage of the third rib on the right side, which articulated also with the right limit of the oblique manubriogladiolar articulation. The left thirteenth rib, or lumbar rib, was four and three quarter inches long. Eight costal cartilages articulated with the left half of the sternum, and on the right side also eight. This last number included the cartilages of the second to the ninth ribs, the first rib on this side having no costal cartilage. The clavicles, whose length always bears a direct proportion to the span of the first ribs, varied in length. The right was six inches long, the rib it lay on having a space of three inches and seven eighths, while the left was five inches and a third long, its rib having a span of three inches. The spinous processes of the fifth, sixth, and seventh cervical vertebræ were not bifid, while the spinous processes of the first and second dorsal resembled in appear-

ance those of the normal sixth and seventh cervical vertebræ. The left transverse processes of the eighth to the eleventh dorsal vertebræ were lower than those on the right side, and were placed so that they lay nearer the spinous processes than their fellows. This asymmetry of the transverse processes was due to the larger number of fully-developed ribs on the left side and to their consequent crowding together. The omohyoid muscles had each only one fleshy belly which arose by an aponeurotic expansion from the clavicle. There was no subclavius present on either side. This absence of, or a variation in, the attachment of the subclavius muscle is by no means uncommon in this extreme condition of exaggerated lower chest. The case I have just described is an extremely exaggerated instance of the conditions I have classified, and as such is rare, but less exaggerated cases are very common and are almost always overlooked. One or more of their abnormal characters have occasionally attracted attention, but the general type of deviation has not been observed.

Asymmetry of the Thorax.

We will now consider the thoracic cavity with regard to the symmetry of its two halves. The normal thorax (if unaffected by the action of any prolonged force, and as a consequence displaying a form deviating somewhat from the original) is usually symmetrical, but it is by no means uncommon to find its halves very unequal.

The *sternum* itself is occasionally asymmetrical, especially the lower portion of the gladiolus. Fig. 18 is an example of this condition. It is due to the presence of one more lateral centre of ossification on one side, or to the absence of one of the lower lateral centres. It may also be due to an asymmetrical arrangement of the pleurostea, which is the normal condition in the higher apes.

The *costal cartilages* in all quadrupeds articulate symmetrically with the sternum, that is the cartilages of both sides are on the same transverse plane. Among the higher apes the reverse is usually the case. The first costal cartilages articulate symmetrically with the manubrium, but the other

true cartilages are attached to the sternum at points corresponding in their level to the intervals between the articulations of their fellows of the opposite side of the chest. This is accompanied by an asymmetrical arrangement of the pleurostea. This asymmetry in the level of the chondro-sternal articulations appears to have escaped the notice of comparative anatomists. In fig. 16, plate xxx, of his 'Monograph on the Structure and Development of the Shoulder Girdle,' Mr. Kitchin Parker figures the sternum of a young orang (*Pithecus satyrus*). In this drawing the pleurostea forming the gladiolus are asymetrically arranged, in fact they alternate exactly in level. The costal cartilages have been depicted as being attached symmetrically to the sternum, and as the pleurostea are asymmetrically arranged, some are shown as being attached to the sternum opposite one of these developmental centres, and not between adjoining centres, as an examination of the skeleton of one of these animals would show to be the true arrangement. Sometimes the cartilages on one side articulate with the sternum at a higher level than those of the opposite side, while at other times the reverse is the case. Sometimes there is no costal asymmetry, but this is exceptional. In the human subject the gladiolus is usually developed by symmetrical pleurostea, consequently the costal cartilages articulating in the intervals of these pleurostea are on the same horizontal level. It is, however, not uncommon to see a partial asymmetry in the attachments of these cartilages, and Figs. 17, 18, and 19 show its frequent appearance. Sometimes one sees a complete retrocession to the type usual among the orang-utans. As a typical example of this retrocession I will describe a case of a child I reported in vol. xviii of the 'Journal of Anatomy and Physiology,' "Costal and Sternal Asymmetry."

The *manubrium* had an oblique lower margin, its direction being from above downwards and to the left. The *gladiolus* presented seven bony centres, each of which was somewhat hexagonal in form. They were arranged in two vertical lines, four being placed on the right side and three on the left. Those on the left side alternated in level with those on the right. Owing to the obliquity of the adjoining margins of the manubrium and gladiolus the second costal cartilages

which are attached to the sternum in the interval between the manubrium and gladiolus were on different levels. Owing also to the asymmetrical arrangement of the pleurostea of the gladiolus, the third, fourth, and fifth costal cartilages on the left side were attached to the sternum at a much lower level than those on the right side. The sixth and seventh cartilages were on the same level on both sides.

Costal asymmetry is always accompanied by an asymmetrical arrangement of the pleurostea.

The *cartilages* may also differ in *length* on opposite sides. I have observed and published several instances of this form of asymmetry.

One or more cartilages may be very *broad*, or may *split* to enclose a foramen, or they may divide and one limb of the bifurcation, the upper, may terminate in a rounded extremity in the intercostal space. This last condition is a rare one. Both, however, may or may not be accompanied by an increase in the breadth of or a fission of the attached rib. I have published several instances of these deviations from the normal in my paper on "Variations in the Human Skeleton," where I have also pointed out their clinical importance in defining the position of viscera. Curiously, the fourth cartilage, like the fourth rib, is most frequently the one affected by this abnormality.

The *ribs* themselves may also divide, and in some rare cases the limbs may unite to enclose a foramen.

Corresponding ribs may vary in *length* on either side, either in their whole length or in the portion intervening between the head and angle. We have already noticed the occasional presence of *asymmetry in the vertebral column*, and for instances of this, as well as of differences in the lengths of the ribs and of their fission, I would refer the reader to the papers already mentioned.

Some Points in the Development of the Sternum.

The sternum, unlike the other bones of the skeleton, continues to increase in size up to extreme old age. I will now trace its development from early life to its fully developed

condition, and will call attention particularly to points in connection with it which I have described in previous papers,[1] avoiding the ordinary description of the bone.

As I said before, the gladiolus is usually developed from pairs of pleurostea arranged symmetrically. In early life these are separated from one another and from the manubrium by bands of hyaline cartilage. The costal cartilages are attached to the sternum, so that the centres of their inner extremities correspond to the cartilaginous intervals between the pleurostea, the first being attached to the manubrium, the second to the adjacent margins of the manubrium, and the upper pleurostea of the gladiolus with the intervening cartilage, and the other true cartilages to the lower pleurostea and the cartilaginous intervals. At an early period there is no indication of the presence of any articulation in connection with the sternum or the costal cartilages. I need not say that the condition of symmetry or asymmetry of the cartilages is present long before there is any appearance of an osseous centre in the sternum, so that the arrangement of the costal cartilages is in no manner dependent on the arrangement of the osseous centres which appear subsequently, since it precedes the process of ossification. The bony centres in the gladiolus gradually increase in size, and in so doing encroach upon the intervening cartilage. Their growth continues till they have united to form a single bone. As they increase in size the band of hyaline cartilage which lies between the manubrium and gladiolus becomes narrower and is altered in character. Along the centre of this cartilage the nuclei arrange themselves transversely to the length of the sternum, and the hyaline cartilage here becomes developed into fibro-cartilage, the fibres of which follow the direction of the nuclei. Even before this process of fibrillation has appeared in this cartilage it has already commenced in that portion of the second costal cartilage which is connected to the upper pleurosteon of the gladiolus. The fibres of the line of fibro-cartilage which develops in the second costal cartilage separate from one another at several points, forming little cavities, which finally unite to form a single articular cavity. This is the first articular

[1] "One Mode of Fracture of the Sternum," 'Trans. Path. Soc.,' 1884. "Sternal and Costal Asymmetry," 'Journal of Anat. and Phys.,' vol. xvii., &c.

cavity that develops in connection with the sternum and costal cartilages. At a later period the same process of fibrillation and cavity formation takes place in that portion of the second costal cartilage which articulates with the manubrium. In some cases the second cartilage remains permanently connected by fibrous tissue to the manubrium, an articular cavity not being developed. The line of fibro-cartilage between the manubrium and gladiolus may follow the same course as did those in the second costal cartilage, and a partial or complete articular cavity may develop in it. Should a single large cavity form, it soon unites with the articular cavity between the gladiolus and the second costal cartilage, the whole being separated from the articular cavity between the manubrium and second costal cartilages by the fibrous attachment of the fibro-cartilage covering the manubrium to the centre of the extremity of the second costal cartilage. In some cases, late in life, even this piece of fibro-cartilage is removed, when there is present only one single articular cavity between the second costal cartilages and the two upper pieces of the sternum. This is shown in Fig. 20.

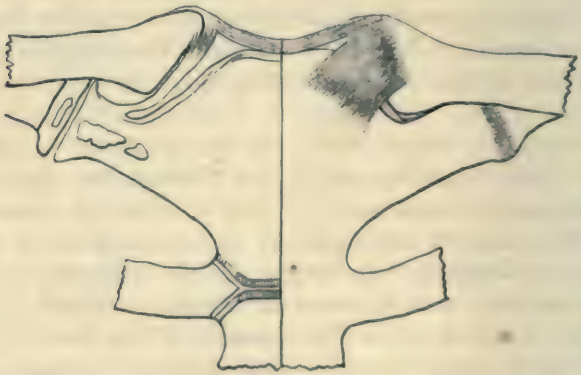


FIG. 20.

Fig. 20 represents the manubrium and its articulations. On the left side the manubrium, the clavicle, and the first and second costal cartilages have been divided vertically, in order to show the character of the sterno-clavicular articulation, the arthrodial joint developed in the ossified first costal cartilage, and the very complete form of arthrodial articulation which

has formed between the manubrium, gladiolus, and second costal cartilage.

The cartilage between the manubrium and gladiolus may only develop one or more partial articular cavities, or no cavity may be formed in its substance. In that case the bones are united by a dense fibrous tissue allowing of a varying amount of movement, but is much less than in the case of an arthrodial joint.

In a still smaller number of cases the pleurostea of the manubrium and gladiolus may encroach upon the intervening cartilage in the same manner in which we have seen them do in the gladiolus and manubrium respectively, and they may fuse together so that the manubrium and gladiolus form a single bone. There is one point I would now mention; it is this: that in those sterna in which the manubrium and gladiolus have united to form a single bone there almost always exists in the first cartilage near its inner extremity an amphiarthrodial joint developed in the substance of the pliant hyaline cartilage. In some rare cases I have found that this process had gone on to the formation of an articular cavity in this situation. As an instance of this condition, I would refer the reader to the description of Fig. 17.

I have already described and illustrated in a previous portion of this paper the mode in which the manubrio-gladiolar articulation is occasionally partly or completely obliterated by pressure during vigorous adult life, so I shall not do more than refer to it here. I have also referred to it in my paper in the 'Transactions of the Pathological Society,' 1886.

Subsequent to the formation of the joints described above, and in a similar manner, articular cavities develop in the inner extremities of the lower true cartilages; in the upper two the cavities are frequently double, as in the second, and in the lower ones usually single. The amount and character of this cavity formation varies within wide limits in different sterna.

If we now examine a sternum of average form from a young adult, the vertical measurement of the first costal cartilage at its junction with the manubrium measures about an inch and a half, that of the second costal cartilage five eighths of an inch, and that of each of the lower true cartilages slightly less. The description of the sternum at this period of life is that given

in the text books. *But the sternum does not retain its present form.* From the manubrium and first rib a process of bone formation extends into the periphery of the inner and outer extremities respectively of the first costal cartilage, and encroaches slowly on the cartilaginous core.

As this cartilage becomes rigid an *amphiarthrodial* joint develops in the bony sheath. This is almost always situated about half an inch from the outer extremity of the cartilage. The several stages in the development of this joint are shown in figs. 2, 3, 4, 5, and 6, Plate VI.

The cartilaginous core then becomes fibrillated along the line of the articulation in the surrounding sheath of bone, so that the flattened opposing ends of the cartilaginous core and of its surrounding bony capsule are connected by an intervening layer of dense fibrous tissue so as to form a complete amphiarthrodial joint.

At a later stage this intervening fibrous tissue is removed, and an articular cavity is formed in the same way as those I have already described. This articular cavity may never extend completely between the ends of the divided cartilage.

As the cavity increases in extent the cartilaginous core is gradually encroached upon by its sheath of true bone, till finally no cartilage is left. At the same time the surface area of the opposing articular extremities of the divided ossified cartilage is increased very considerably by the deposit of bone around its margins, and a strong fibrous capsule surrounds this joint, which is now *arthrodial* in character. See figs. 2 and 6, Plate VI, and Fig. 20.

If we now examine the first rib, it will be found difficult or impossible to define its original limit, as the outer half inch of cartilage forms practically a portion of it. The manubrium also is inseparable from the first costal cartilage; in fact the manubrium with the greater portion of this cartilage forms a single bone, which it is impossible to separate by its structure into its original component parts. Fig. 20 represents this condition diagramatically.

In some rare cases the other true costal cartilages may become ossified in the same manner, and similar arthrodial joints are developed in their substance at a distance of about half an inch from their outer extremities.

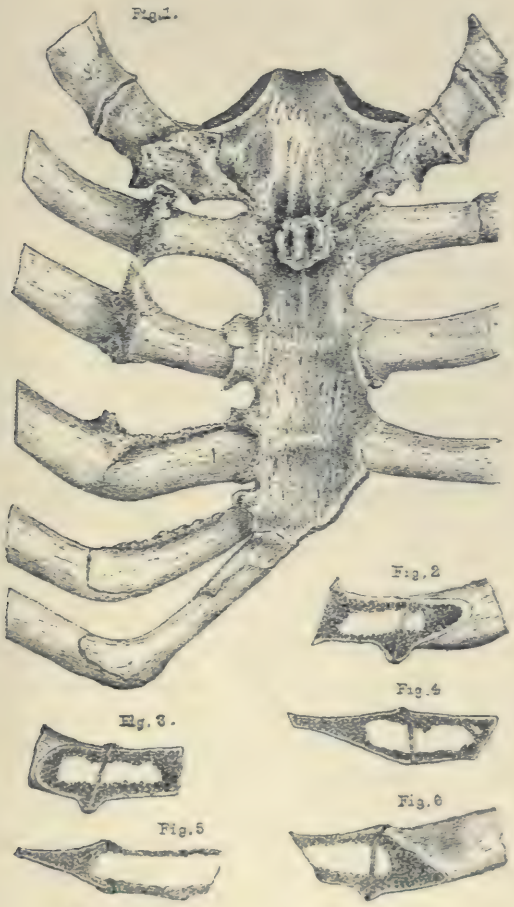


Fig. 1 represents the posterior aspect of the sternum and costal cartilages. Both first costal cartilages have been fractured. The sternum has been fractured and the fragments have united without any displacement. The left second and third costal cartilages have been fractured through their outer extremities, and so-called costo-chondral dislocations have been produced.

Figs. 2, 3, 4, 5 and 6 represent vertical and horizontal sections of the first rib and its cartilage, and show the gradual development of the joint in the ossifying cartilage.

I will discuss the physical causes which determine the formation of the various joints in connection with the sternum and the costal cartilages at a subsequent stage of this paper, as it will be more convenient then than now.

Relative Strength of the Ribs. The Influence exerted on the Position of the Ribs and Sternum by Flexion or Extension of the Spinal Column.

Examining the several ribs, one is struck by the excessive strength of the first rib as compared with that of the others.

Even in the body of a feeble old woman, in whom all the ribs are easily broken, very much more force is required to break the first rib than the rest. This disproportion is more marked in a subject whose osseous system is in good condition.

The second rib requires for its fracture the exertion of more force than do the ribs below it, but in this instance the difference in amount is very small as compared with that between the first and other ribs.

The cause of this disparity in the resisting power of the several ribs can be best shown by making a vertical section through the thoracic wall. We will, for instance, examine the sections of the ribs of a powerfully built man, the side of the thorax having been divided vertically in its median line.[1] The section of the first rib is placed obliquely, its inner margin being on a plane above the level of its outer. It is more than an inch in breadth, and its compact tissue is largely in excess of that present in the other ribs. It is especially abundant along its inner or upper margin, where it is a quarter of an inch broad. The necessity for its excessive thickness along this border will be seen later, when we consider the mode in which the clavicle transmits force to the thorax. The first rib is not so thick as the second, and the second is not so thick as the third and other ribs.

The section of the second rib shows a somewhat thicker layer of compact tissue and a less amount of cancellous tissue than do those of the lower ribs.

[1] I have figured such a section in the 'Trans. Path. Soc.,' 1886.

The shaft of the first rib is so bent that while its anterior portion, continuing the direction of the first costal cartilage, slopes very slightly upwards, its posterior half or two thirds ascends very considerably from the plane of its anterior portion. The amount of obliquity may be gauged by the fact that the upper border of the first costal cartilage is on the same horizontal plane as the body of the third dorsal vertebra. In the bodies of labourers it may correspond to the body of the fourth dorsal vertebra. The head of the first rib forms a very freely movable articulation with the body of the first dorsal vertebra.

I will just refer here to that ligament which I have already described fully, and which, for the sake of convenience, I called the *intercostal ligament*, in order to save repetition of its description.

We now see that the first rib and its costal cartilage are capable of transmitting to the sternum an amount of force *enormously in excess* of that which can be exerted by each of the other ribs and cartilages.

What influence does the movement of flexion of the dorsal spine exercise on this portion of the spinal column, on the ribs and on the sternum? We will determine this fact experimentally.

1. If a spinal column with the ligaments attached be powerfully flexed, the convexity of the dorsal region is much increased, so that it forms an arc whose radius is much shorter than that of the dorsal curve in the position of rest. It is seen that the forward movement of the vertebræ upon one another is more marked in the upper than in the lower dorsal region.

2. If a spinal column be taken with the ribs still attached to the bodies and transverse processes by ligaments, but deprived of any intercostal structures, and this be flexed, the extremities of the ribs are seen to be approximated to one another, and this approximation is more marked in the upper dorsal region than elsewhere, and in the first rib than in the second. This depression of the upper ribs is due to the fact that the ribs are to a certain extent fixed radii of the arc, their heads and tubercles being attached to the arc. The leverage exerted by the vertebræ upon the ribs in causing their approximation is very slight, and can be opposed by a slight force, as the

ligamentous connection between them is comparatively lax in this movement.

Besides this movement of approximation of the upper ribs, there is another movement, viz. that of the first rib along the plane of the second, and the second along the plane of the third. This is due to the greater mobility of the first vertebra over the second, and of the second over the third, and so on.

3. Let a body be taken and the intercostal muscles removed from the upper two interspaces, and the intercostal ligament and pleura be left in position. Divide the sternum transversely between the attachments of the second and third costal cartilages, and remove a piece of bone about half an inch broad at this point. On making the movement of flexion of the spinal column, the upper border of the lower fragment is seen to be pushed forwards owing to the forward movement of the third rib upon the fourth, and slightly to the movement of the fourth upon the fifth. The lower ribs do not seem to move much upon one another so as to project the sternum. This is owing probably to the very oblique direction of their shafts and cartilages in regard to the sternum. The presence of the abdominal contents serves to assist in projecting forwards the lower fragment, as this forward movement of the lower end of the sternum is not obtained if the abdomen has been opened and the viscera removed. While the upper border of the lower fragment of the sternum moves forward, the upper fragment grasped by the first and second costal cartilages follows the upper two ribs downwards by a rotatory movement, the axis of rotation corresponding to the costo-vertebral articulations, and the lower margin of the upper fragment passes behind the lower fragment.

The factors producing this movement are two: one is the increased convexity of the dorsal curve, and the other the intercostal ligament whose fibres are put on the stretch by the forward movement of the first two ribs.

4. Let a body be taken, and let the intercostal muscles be removed from the first two spaces, the intercostal ligament being left. Divide the manubrium transversely along the upper margin of the second costal cartilages, and remove a portion of the manubrium about half an inch in breadth. On flexing the column the lower fragment of the sternum is forced

forwards by the the forward movement of the ribs, chiefly of the second, third, and fourth, and by the pressure of the abdominal viscera, while the manubrium passes downwards behind the upper extremity of the lower fragment. The causes of this rotation are similar to those in the last experiment. If a portion of the sternum be now removed from the gladiolus transversely, between the attachments of the second and third costal cartilages, and a flexion movement of the column be made, the portion of the sternum attached to the first ribs and cartilages will pass beneath that portion held by the second costal cartilages, while this again will pass beneath the upper margin of the lower fragment of the sternum, projected forwards by the third and other ribs and the abdominal viscera.

If the sternum be now divided between the attachments of the third and fourth costal cartilages, a portion removed, and the column flexed, there is seen to be but a very slight tendency to backward displacement of the lower margin of the upper fragment, or to forward displacement of the upper margin of the lower fragment held by the fifth costal cartilages.

The force exerted in the rotation of these fragments around the attachments of their corresponding ribs to the column is very considerable, especially in the case of the manubrium. It is still greater if the internal intercostal muscles are left to assist the intercostal ligament. The above displacement of the sternal fragments is much exaggerated on increasing still further the convexity of the upper part of the dorsal spine by dividing the interarticular fibro-cartilages between the first, second, and third dorsal vertebræ with a chisel, and displacing these vertebræ forwards upon one another.

I will add to these one more experiment, as it shows one of the factors that determine the *formation of the arthrodial joint in the ossified first costal cartilage.*

Take the body of a powerful labourer in whom the first costal cartilages have undergone ossification, and have each developed a loose arthrodial joint in its substance, and in whom the manubrio-sternal articulation is of the same arthrodial character. Remove the intercostal muscles from the first space. On flexing the spine violently, the first rib moves forward upon the second and the second on the third, but the

manubrium prevents the approximation of their anterior extremities which was observed in the previous experiments, so that the intercostal ligament in this space is seen to be vigorously stretched.

The tension of the intercostal ligament causes the first rib to rotate somewhat so that its upper aspect is directed more outwards than before, and it is seen that it is this movement of the rib, combined with the downward movement of the sternum, which necessitates the formation of the arthrodial joint in the ossified and inelastic first cartilage. The normal elastic costal cartilage allows of this rotation of the rib, but as soon as the cortex becomes ossified, the movement of rotation causes the development of a movable joint in the rigid cortex and later in the whole thickness of the ossified rod.

If in the same subject the upper dorsal and cervical spine be extended, the intercostal ligament is rendered lax by the backward movement of the first rib on the second, and there is seen to be a movement of rotation taking place in the arthrodial joint in the first cartilage.

Let a subject be taken and the sternum be divided transversely above the levels of the attachment of the second, third, and fourth costal cartilages. On *over-extending* the dorsal and cervical spine the manubrium and portion of sternum held by the second costal cartilages are separated from one another and from the rest of the sternum, this separation being more marked between the two portions of the manubrium. Besides this vertical displacement, the upper portion of the manubrium is displaced backwards from its normal plane, and the portion of sternum held by the second cartilages undergoes a similar though slighter backward displacement. Little or no movement takes place between the third and fourth costal cartilages and their segments of the gladiolus.

The importance of the changes we have considered will be observed when we discuss the mode of fracture and dislocation of the sternum and the mode of development of the arthrodial articulations in and about the sternum.

Connection of the Shoulder Girdle to the Thorax.

Variations in length of clavicles and in size of scapulæ.

I have been unable to confirm the statement usually made by anatomists that the right clavicle is shorter and more curved than the left. This they attribute to the excessive amount of work performed by it as compared to that done by the left. In the large majority of the bodies which I have examined in the dissecting room I have found the clavicles of equal length on both sides, but in a comparatively small proportion of cases they have varied in length. On examining into the causes of this variation I was unable to detect any connection between the amount of work performed by that arm and shoulder and the amount of diminution in length of the bones. In fact I found that the shorter clavicle was about as frequently present on the left side of the body as it was on the right side. I found, however, that *the length of the clavicle varied directly as the spans of the first ribs and cartilages, so that, when these were asymmetrical, as they are not uncommonly, the clavicles were asymmetrical in a corresponding proportion.*

As an extreme instance of this variation in the ribs and clavicles, I would refer the reader to the description of the case on page 387 of this paper. I also found that not only did the clavicles vary in length on either side directly as the spans of the first ribs and cartilages, but *that the size of the scapulæ varied directly as the length of the clavicles, consequently as the spans of the first ribs and cartilages.* This variation in size is not so marked as in the case of the clavicles for reasons that are obvious.

Function of the Clavicle, and the Movements it is capable of.

In the consideration of the mode of transmission of force we will exclude the action of muscles, but will limit ourselves to the ligamentous connection of the bones to one another.

The muscles assist to a great extent in fixing the bones in position, and in determining the movements, yet in the transmission of any considerable weight or force the bony and

ligamentous structures must perform the chief share of the work.

The arm and scapula are connected to the clavicle by the powerful coraco- and acromio-clavicular ligaments, and these connections serve to transmit to the clavicle the ordinary weight of the arm or of that added to the weight of anything supported by it, or force applied directly to the arm or scapula.

The clavicle is connected to the sternum and first costal cartilage by very powerful ligaments which combine to retain the base of the triangular facet on its inner extremity in contact with the sternum and cartilage. The ligaments are the anterior and posterior costo-sternal, the interclavicular, and the interarticular fibro-cartilage. The shaft of the clavicle then lies on the first cartilage, to which it is connected by the very strong rhomboid ligament.

In the normal erect position the clavicle rests on the anterior extremity of the first rib, and, as we have already seen in this paper, there is in some labourers at this point a raised table of bone on which the clavicle rests, and which, with the corresponding facet on the clavicle, is frequently covered by synovial membrane.

From this position the clavicle enjoys great freedom of antero-posterior movement, its inner extremity being practically a fixed point or fulcrum.

If the outer extremity of the clavicle be forced downwards and forwards the clavicle rests on the outer extremity of the first costal cartilage, while the interarticular fibro-cartilage and posterior sterno-clavicular rhomboid ligaments are rendered tense. The amount of forward movement of the clavicle from its normal position on the first rib is consequently slight. In some occupations, as in the milkman, the clavicles rest habitually on the costal cartilages. For a well-marked instance of this condition, see the 'Journal of Anatomy and Physiology,' 1886, p. 395, "Some Variations in the Human Skeleton."

If the outer extremity of the clavicle be forced directly backwards in a perfectly horizontal plane it passes backwards in that plane till it is stopped by the oblique ascent of the first rib covered by the scalenus medius. This obliquity of the position of the first rib we have already considered on p. 398.

If the outer end of the clavicle be forced still further backwards without any attempt being made to retain it in the same plane the clavicle will cross the inclined plane of the first rib and pass upwards and backwards till it rests on the neck of the first rib, from which it will be separated by the scalene muscles. In this sweep backwards the clavicle has rested on every portion of the first rib. This movement of the clavicle upwards and backwards along the oblique ascent of the first rib may be observed on the living subject by drawing the shoulders backwards. It is then seen that besides the posterior displacement there is a very considerable ascent of the shoulder. If, when the arms are in this position, traction be exerted on them in the same direction, namely, upwards and backwards, the *clavicles will by their attachments to the first ribs, first costal cartilages and sternum, raise these structures, and consequently the other ribs, and will place the thorax in the condition in which it exists in complete inspiration.* The importance of this movement is seen in the performance of artificial respiration in the completely *unconscious* subject in whom the muscles can exert no influence but that of elastic structures on the movements of the thorax.

In the backward sweep of the clavicle, strain is thrown upon the interarticular fibro-cartilage, anterior sterno-clavicular and rhomboid ligaments, and the inner end of the clavicle moves slightly forwards.

In determining the result of *forcing the outer end of the clavicle upwards and downwards*, take a thorax with the clavicles attached, and from the first two intercostal spaces remove the intercostal muscles, leaving the *intercostal ligament* connecting the first, second, and third ribs. Choose a subject in which the manubrio-gladiolar articulation is arthrodial in character.

Raise the outer end of the clavicle directly upwards from its normal position. The rhomboid ligament of the same side is rendered very tense, the first rib and cartilage are raised by the upward traction exerted on them by the rhomboid ligament, the *intercostal ligament* is rendered tense, and raises by its traction the second rib, and this, by means of the *intercostal ligament* between it and the third rib, raises the third rib to a less degree.

The manubrium is raised a little in a horizontal plane, while

it is rotated around an antero-posterior axis. This rotation is produced partly by the downward pressure of the inner end of the clavicle, but chiefly by the upward movement of the first costal cartilage and rib which is itself produced by the traction of the rhomboid ligament. The second rib and cartilage assist slightly in rotating the manubrium. The movement of rotation of the manubrium is permitted by the presence of the manubrio-gladiolar articulation.

This rotation of the manubrium necessitates a depression of the opposite first costal cartilage, first rib, and clavicle, a relaxation of the *intercostal ligament*, and a slighter depression of the second rib and cartilage.

These then are the conditions which are present when the body is suspended by one arm, and the importance of the intercostal ligament in transmitting the tension of the rhomboid ligament to the thorax is well seen.

Take the same subject and depress the outer extremity of the clavicle vertically from its normal position. The interclavicular, interarticular, anterior and posterior sterno-clavicular ligaments are rendered tense, the clavicle rests upon the upper surface of the anterior extremity of the first rib, and on the second rib on a vertical level considerably posterior to the point of impact on the first rib. The amount of pressure exerted on the second rib varies with the depth of the interspace between the first and second ribs, and is therefore greater in men than in women. See p. 385.

The first rib is depressed by this pressure, as is also the second to a much less degree. The *intercostal ligament* on this side is relaxed. The manubrium is rotated around an antero-posterior axis, but in a direction the reverse of that in the last experiment. This rotation is produced by the traction exerted by the ligaments upon the manubrium, and to a greater extent by the force exerted upon it by the depressed first costal cartilage.

The first rib and cartilage, with the clavicle of the opposite side, are raised, the *intercostal ligament* is rendered tense, and the second rib is raised to a less degree, and the third still less.

If pressure be exerted in a downward direction on the outer ends of both clavicles the upper two ribs are approximated, and the upper dorsal spine is flexed, but no visible change is seen

in the position of the manubrium. If, however, this bone be divided transversely along the upper border of the second costal cartilage, and the same pressure be exerted on the clavicles, the manubrium is at once driven downwards and backwards behind the gladiolus.

Let a body be chosen in which there is no articulation between the manubrium and gladiolus, and prepared as for the previous experiments. On exerting an upward pressure on the outer end of the clavicle, the rhomboid ligament raises the first rib and cartilage and, by means of the intercostal ligament, the second and third ribs. The upper end of the sternum is forced a little to the other side of the median line, and a slight depression of the upper ribs on the opposite side takes place, especially of the first rib and cartilage. The lower portion of the sternum moves very slightly, though it is quite apparent that the cartilages of the lower true ribs are acted upon by a force whose direction is the reverse of that exerted on the opposite first rib by the manubrium. The whole sternum rotates slightly on an antero-posterior axis that passes through the seat of the manubrio-gladiolar articulation; so that *practically this point of the sternum is exposed to a transverse breaking strain the amount of which depends on the amount of force exerted on the clavicle.* On applying a downward pressure the reverse condition is the result, *and in this case the strain thrown on the sternum at the junction of the manubrium and gladiolus is much more severe than in the last experiment.*

In sterna presenting joints varying in degree of movements from the loose arthrodial to the very fixed form of amphiarthrodial, which last condition allows of very slight movement indeed, the results of the application of pressure to the clavicle are intermediate in character between the extremes already described.

From these experiments it would appear that the clavicles by their leverage action only assist indirectly in the development of a joint in the ossified first costal cartilage, and by this I mean that they do so in so far as they depress or raise the ribs and sternum, rotating them on one another and on the spinal column as in the normal movements of respiration, and by generating a condition of rigidity necessitating the presence of

a joint. We are now in a position to answer two questions, namely:

1st. Why does the first costal cartilage become ossified so long before any of the others? And 2nd. What factors determine the formation of an articulation between the manubrium and gladiolus? I will discuss only the first of them in this paper.

Why does the First Costal Cartilage undergo its Early Conversion into Bone?

I have described on page 394 the gradual conversion of the first costal cartilage into true bone, and the development of an amphiarthrodial and later of an arthrodial articulation in its substance, and on page 401 we have considered the factors which determine the formation of this joint. I believe that the ossification of the first costal cartilage so long before any of the others is entirely due to the enormous strain to which it is subjected in transmitting the force, applied through the clavicle to the thorax.

In women who have led indolent lives this cartilage has not undergone osseous change even in very old age, while in labourers who have begun heavy work when quite young, the first cartilage becomes ossified throughout at a comparatively early period of life. Not uncommonly the other cartilages do not present the slightest indication of change. These facts alone are quite sufficient to show *that its conversion into bone is due to the strain it is exposed to.* An instance of fusion of the first and second costal cartilages, which I have described on p. 396 of the 'Journal of Anatomy and Physiology,' 1886, demonstrates very clearly this connection between pressure as a cause and ossification as a result.

I will first describe the fractures that can be produced *experimentally in the adult dead subject* by the application of a sudden force to the shoulder girdle, and after that I will analyse those pathological instances of similar fractures which I have collected from the dissecting room.

Experimental Observations on the Effect of the Application of Sudden Force to the Shoulder Girdle.

The result of the sudden application of force varies much with the manner in which that force is applied. For instance, if a sharp blow be struck with a light hammer, the bone struck by the hammer is usually broken at the point of impact, but if the bone intended to receive the direct influence of the blow be carefully padded, and be then struck by a heavy weight, it will probably not yield itself, but transmit the applied force to other bones, some of which may yield instead.

If the outer end of the shoulder as represented by the acromion be struck vertically, obliquely, or at right angles to the vertical by a light hammer the acromion is fractured with the greatest facility. This fracture usually corresponds in position with the seat of fracture as found pathologically, and its direction will be found to vary within the same limits. In this artificial fracture the line of fracture may pass in front of or behind the oval clavicular facet or through any portion of its area. Using the same light hammer, but with greater force, the clavicle may be broken. It is broken much more easily in that portion of its extent which lies outside the conoid tubercle. I have not been able to break the clavicle in the dead body by the application of a horizontal force to its outer extremity. I would object at this point to a statement made in surgical works that *the part between the two curves is generally the weakest part of the bone and hence more liable to fracture*, and I hope to show, both experimentally and by pathological experience, that this statement is in the adult subject inaccurate and incorrect. As we have already seen, the direct application of a sharp sudden blow fractures the flattened outer third of the bone with comparative facility, while the more rounded inner two thirds of the bone usually resist this form of blow.

As regards displacement of the fragments in fracture of the clavicle, I would say a few words, and again, in this consideration of it, I would exclude as much as possible the action of

muscles. If we divide the clavicle transversely outside the attachment of the conoid or trapezoid ligaments and place the body in the erect position, the outer fragment follows the movements of the scapula and arm and its outer end is directed more anteriorly than before. At the same time the whole of the fragment falls below its original level, while the outer extremity of the inner fragment is held down in its original position by the tension exerted by the coraco-clavicular ligaments. The weight of the arm causes the scapula to rotate so that the glenoid cavity is depressed, and looks forwards, outwards, and downwards, the attachment of the conoid and trapezoid ligaments to the coracoid process representing the fixed point about which the whole scapula rotates. The shoulder, besides being depressed, is also thrown considerably in front of its normal position.

If the clavicle be sawn through from above, so that the lower limit of the incision corresponds accurately to the interval between the conoid and trapezoid ligaments, or rather, if it run through the attachment of the trapezoid ligament, and these ligaments be not torn by the saw, very slight displacement of the fragments may ensue. The shoulder falls a little forwards and downwards, though less than in the last experiment, and the outer fragment slopes more downwards and forwards than before.

If the section be so made that it extends through the attachment of the conoid ligament, though the fragments may remain in contact, the outer is much altered from the original position both horizontally and vertically as before.

But should the fracture of the bones at either of these points have been produced by applied force, the displacement of the outer fragment is always considerable. It is *displaced downwards by the blow*, so as to be below the plane of the inner fragment, and its outer extremity is drawn forwards and downwards by the traction exerted on it by the arm and by the consequent rotation of the scapula.

As this portion of the clavicle is always broken in this way, I think experiment at least shows that the statement in works on surgery, that when fracture of the clavicle takes place between the conoid and trapezoid ligaments there is *scarcely any displacement* of either fragment of bone, is incorrect, and

the subsequent examination of my pathological specimens will help to prove this.

The explanation of the mode in which the fragments are displaced in fracture outside the coraco-clavicular ligaments also appears to me unsatisfactory. We have already seen experimentally that the depression produced by the injury, the weight of the arm, and the consequent rotation of the scapula, are quite sufficient to account for the depression of the outer fragment, and the forward projection of its outer extremity, without considering it necessary to add to these factors the influence of the contraction of the muscles on the fragment. For instance, in 'Holmes's System,' vol. i, page 950, we find that the inner end of the outer fragment is "drawn upwards and outwards by the action of the clavicular portion of the trapezius muscle, while the outer or articulating surface is directed downwards and inwards by the weight of the arm and the action of the muscles passing from the chest to the shoulder." We find that exactly the same displacement is produced in the dead subject when the muscles can have no active influence, as in the dissected subject in which all the muscles have been removed. I will discuss later the relative frequency of fractures of different parts of the bone, and compare my experience with that given in the text-books.

Before leaving fracture of the clavicle, I would refer to the *cause of the displacement* present when the clavicle is fractured through its centre, which *is said to be* the weakest portion of the bone ('Holmes's System,' vol. i, page 948).

Let the subject be placed in the erect position by slinging it by the head and allow the arms to hang naturally from the side. To exclude the possibility of muscular tension in any way affecting the position of the inner fragment, remove from it the attachments of the pectoralis major and sterno-mastoid.

Note accurately the level of the inner half of the bone, and then divide the clavicle through its middle. The outer fragment at once falls to a lower level, while at the same time its outer extremity is drawn forwards. These movements are evidently due to the weight of the arm and scapula, the latter gliding downwards and forwards over the side of the chest.

The outer extremity of the inner fragment *rises from about*

half an inch to three quarters of an inch. This elevation of the inner fragment can only be due to the tension exerted by the weight of the arm and scapula on the interclavicular and interarticular fibro-cartilage, and the other sterno-clavicular ligaments, to the elastic recoil of the first rib and cartilage after the removal of the pressure exerted upon them by the weight of the arm transmitted normally by the clavicle, as well as to the elevation of this costal arch secondary to the depression of the first costal arch of the opposite side acted on by the unbalanced weight of its arm.

Now take a subject in which the manubrium has united to the gladiolus by bone, and in which the first costal cartilage is still cartilaginous throughout. Place the body and arm in the natural position and carefully pad the upper aspect of the shoulder.

Strike a heavy blow with a weighty hammer vertically on the upper aspect of the shoulder. In the majority of cases the sternum alone will fracture transversely, usually just above the attachment of the second costal cartilages to it. In other cases the fracture may be oblique, and in a fewer number it may be accompanied by a fracture of one or both first costal cartilages. In some the second, and even the third rib may be broken by the clavicle, as after the fracture of the sternum and first cartilage it descends under the influence of the applied force much below its normal level.

The fracture of the sternum is usually accompanied by no displacement of the fragments, and in many cases could not be determined unless the anterior surface of the sternum were exposed by the removal of its periosteum. In these cases there is rarely any chipping of the fragments. How is the presence of this fracture to be shown after death? From the comparative facility with which it is produced, it cannot be a rare accident, especially, as I shall show later that fractures of the sternum which leave undoubted traces of their occurrence are not unusual. I found myself face to face with this same difficulty when I was working at the fractures of the larynx and hyoid bone. I found that I was able to fracture these structures with comparative facility in the dead subject, and arguing from the occupation and character of life of those classes from which hospital subjects are derived I concluded

that these fractures must be much more common than the literature of the subject would lead one to expect. The researches[1] I made verified my expectations and yet not completely. The reason was, that on the dead subject I could fracture the thyroid cartilage in the middle line, the ala of the thyroid cartilages and the cornua of the hyoid bones producing slight, if any rupture of the periosteum and frequently no displacement of fragments. But when on the dead subjects I looked for indications of these fractures, which formed the majority of the fractures I produced artificially, I found I was unable to assert positively that any particular alterations in the form of the thyroid cartilage and hyoid bone were fractures or merely deviations from the normal. So that practically, as regards the larynx, this class of fracture must be regarded as lost since it leaves no certain indication of its occurrence. *In the same way it is certain that these fractures of the sternum and, as I will show later, the fractures of the first rib or its cartilage which are unaccompanied by any separation of fragments, leave very slight and uncertain indications of their occurrence if examined some years after the injury. Yet these fractures form a very large proportion of fractures of the sternum, first rib, and cartilage, which are produced artificially.*

If a subject be chosen in which the manubrium forms with the gladiolus a loose arthrodial joint, and in which the cartilage of the first rib has undergone no osseous change, and the same heavy blow be struck, as in the last experiment, you may get fracture of one or both first costal cartilages, but the sternum itself is not broken. The arthrodial joint has permitted the gladiolus to rotate readily round an antero-posterior axis. The second and third ribs or their cartilages on the same side as the clavicle struck may or may not be injured. They are more liable to suffer injury from a heavy blow than from a lighter one, and in a subject in which the upper ribs are closely approximated rather than in one in which the upper intercostal spaces are broad.

The fracture of the unossified first cartilage is, unlike that of the other costal cartilages, almost always oblique, and is unaccompanied by any displacement of fragments. *In very*

[1] "Fractures of the Hyoid Bone and Larynx," 'Trans. Path. Soc.,' 1885.

many cases the fracture is incomplete, that is, it does not extend completely through the whole thickness of the cartilage.

If subjects be chosen in which the sternal joint varies in mobility from complete rigidity to that of an amphiarthrodial character, the same heavy blow is followed by fracture of one or rarely both cartilages, accompanied or not by fracture of the sternum, usually just about or above the position of the sternal joint.

If a subject be chosen in which the first cartilage has ossified sufficiently to contain an arthrodial joint, and a heavy blow be struck as before, the portion of the first costal cartilage which is attached to the sternum fractures usually in a direction obliquely downwards and outwards, commencing above close to the manubrium. The presence of the arthrodial joint does not appear to save the ossified inner portion of the cartilage. If pressure be gradually applied the clavicle is seen to press on the rib and to depress it somewhat, and then the clavicle bears directly on the sternal portion of the ossified cartilage and causes its fracture.

Should the joint in the ossified cartilage be amphiarthrodial in character the annectant fibrous tissue often yields under the pressure, and what might be regarded as a *temporary dislocation* takes place. The extremities of the ossified cartilage return to their original position when the pressure is removed from them.

If in another subject the outer end of the clavicle be forced backwards, so that it rests upon the first rib outside its tubercle, being separated from it by the scalenus medius, and a heavy blow be struck horizontally backwards on its padded outer extremity, in some rare cases the inner end of the clavicle is dislocated forwards, but in the large majority of cases the first rib is fractured at the point of impact. *The facility with which this fracture of the first rib is produced is remarkable,* and if one compares the relative thickness and strength of the the first rib and clavicle, and the mechanical advantage of the action of the clavicle upon the first rib, one would not be surprised to find this fracture occur not uncommonly during lifetime. But strange to say, I found only one case of fracture of the first rib on record, and surgeons seem to agree in saying that it does not occur, or if it

does that it *is extremely rare*. In this fracture of the first rib I experienced the same difficulty in determining its existence after death that I did in cases of fracture of the larynx and hyoid bone, for the reason that the artificial fracture was always oblique, that the fragments did not overlap in a horizontal plane, and there was rarely any displacement of fragments. When any deviation from the original curve of the rib was produced in these artificial fractures it was in a horizontal plane and the prominence produced was on the outer side.

On fixing the clavicle so that it lay on any point of the first rib midway between the limits already experimented on, I obtained, by the exertion of comparatively little force applied vertically or obliquely downwards and backwards on the padded outer end of the clavicle, a fracture of the first rib. In all these cases the displacement of the fragments was very slight, the fracture was often oblique, and in not a few cases incomplete. In some cases the fracture was double, the rib yielding at points in front and behind the point of impact, the anterior fracture not uncommonly passing through the outer end of the partly ossified costal cartilage. Should any arthrodial joint be present here only the posterior fracture is produced. In all these fractures of the first rib and sternum I was surprised at the remarkable facility with which they were produced, and, judging from the appearances of many, concluded that it would be impossible to determine their occurrence if any considerable interval of time elapsed between their production and their post-mortem examination.

Having now discussed the theoretical and experimental part of the subject, I will go on to the consideration of the specimens of fractures and injuries of the shoulder-girdle and its connections to the thorax, which I have obtained from the dissecting room. During the last few years I have examined the bones of every subject dissected in the dissecting room, and my experience of the fractures present should represent the liability to fracture of several hundred adult subjects of a class which is particularly exposed to injury in all forms. I would be more accurate if I said these fractures represent the recoverable fractures, as they of course do not represent the cases fatal through the fracture or through the injury producing the fracture.

In Specimen 1, which was evidently produced by a fall on the shoulder, the head of the humerus is quite flattened in a vertical plane. This surface looks directly inwards and with the slight convexity it presents articulates with the glenoid cavity. The glenoid cavity is much altered in appearance. There has been considerable destruction of the floor of the cavity so that the length of the anatomical neck is diminished, while the area of the cavity is much increased by the marginal deposit of bone. There is also an ununited fracture of the acromion. Its direction is backwards and slightly outwards from a point a quarter of an inch internal to the clavicular facet. The force applied to the outer aspect of the humerus appears to have produced most change in the opposing surfaces of the humerus and scapula. This condition would, I suppose, be regarded as an instance of *rheumatoid arthritis* secondary to injury, but I have discussed the pathology of this specimen, and the condition present, in a paper, "The Causation and Pathology of the so-called Disease, Rheumatoid Arthritis, and of Senile Changes," in the 'Transactions' of the Pathological Society for 1886. In that paper I have figured a similar specimen.

Specimen 2 shows but slight change in the head of the humerus, and the scapula presents a *united fracture* which has passed *through the surgical neck* of the scapula. There is no comminution or fracture of the rest of the scapula. The direction of the glenoid cavity is slightly altered, owing to the downward displacement of the glenoid cavity and coracoid process. This would appear to be a *unique specimen*, judging from the literature of the subject, as in the three published cases of fracture of the surgical neck of the scapula there was also a general comminution of the body of the bone. One of these specimens is in the museum of Guy's Hospital, Spec. 1097[85]; another in the museum of the Royal College of Surgeons; and the third is reported by Du Verney, "Traité des Maladies des Os,' 1751, tome 1, p. 227.

The fracture of the scapula must have resulted from an injury which was similar in character to that which produced the extensive so-called rheumatoid changes in the articular surfaces of Specimen 1.

I found a great many instances of fractures of the acromion,

but did not consider this unnatural, judging from the facility with which I was able to break the acromion by a blow applied horizontally as in a fall on the shoulder, or vertically as when the shoulder is struck by a falling body. In many of those in which the fracture was in front of the clavicular facet I found considerable displacement of the fragments. The direction and seat of the fracture varied within a broad limit, corresponding to the direction of the fractures I obtained experimentally on the dead body. In some cases the fragments were connected by intervening fibrous tissue, while in other cases they were united by a fibrous capsule lined by a synovial membrane. The latter arthrodial joint allowed of much more freedom of movement than the amphiarthrodial joint, and the extent of development present in the newly-formed articulation was evidently dependent on the amount of movement to which it had been subjected by the occupation of the individual and to a less degree upon the direction and seat of the fracture.

In almost all these cases *the shoulder-joints presented the changes which are usually described as rheumatoid arthritis*, but which I think are better described as *pressure changes*. These, I am convinced, must have been consequent on the injury that caused the fracture of the acromion, so that the fracture and the joint changes were both expressions of the blow received, which was the cause of both.

As one would also expect, I found that fracture of the acromion process was much more common on the right side. I found many specimens which were apparently instances of united fracture of the acromion unaccompanied by displacement, which formed, as I have shown, a large proportion of fractures experimentally produced, but which were of necessity doubtful, as union must have been perfect.

In the museum of Guy's Hospital I found two undeniable instances of bony union following fracture of the acromion, so negativing the statement that fractured acromion is always followed by ligamentous union.

As fair instances of ununited fracture of the acromion, I will describe briefly the five following specimens, and after them the two examples of united fracture.

A. Ununited fracture of right acromion. Its direction is

outwards from just behind the anterior margin of the clavicular facet. The outer fragment is connected to the acromion by ligamentous tissue; there is no synovial cavity. It is displaced forwards in a horizontal plane. There are extensive so-called rheumatoid changes in the shoulder-joint.

B. Ununited fracture of right acromion. Its direction is outwards from a point behind the clavicular facet. The surfaces of the fragments are smooth and eburnated, and are connected by a capsule lined by synovial membrane. The glenoid cavity presents but slight change.

C. Ununited fracture of right acromion. Its direction is outwards from the centre of the clavicular facet. There is no displacement, and the fragments are united by dense ligamentous tissue. Extensive rheumatoid changes are present in the shoulder-joint.

D. Ununited fracture of right acromion. Its direction is outwards from a point just behind the clavicular facet. The union is by dense ligamentous tissue. There is no displacement of fragments. There are extensive rheumatoid changes in the shoulder-joint.

E. Ununited fracture of right acromion. Its direction is outwards and backwards from a point just in front of the clavicular facet. The fragment is displaced somewhat downwards and forwards. The surfaces are united by a dense ligamentous tissue.

Specimen 1297[25] presents a united fracture of the acromion of the left side. Its direction is outwards from *the centre of the clavicular facet*. The fracture has united firmly by bone. There is considerable horizontal displacement of the outer fragment, the angular intervals between it and the inner fragment being filled in by osseous material. The specimen also shows an unreduced subcoracoid dislocation of the head of the humerus.

Specimen 1297[30] shows some severe injury to the upper extremity of the humerus, which is much deformed and shortened. The acromion has been fractured and has united by bone. The direction of the fracture is outwards from a point *a quarter of an inch behind the clavicular facet*. The outer fragment slopes downwards and outwards. There is more callus uniting

the fragments on the lower than on the upper surface of the fracture.

The complete rest of the parts necessitated by the more severe injury to the shoulder-joint in both these cases has permitted of the fragments of the acromion being kept sufficiently at rest to allow of their uniting by bone.

If one examines the directions of the fractures in these five cases of ununited fracture and in the two cases of united fracture, one sees that the seat of the fractures varies considerably in position and in direction within wide limits; also that they differ in no way from the fractures produced artificially in the dead body. Though I cannot speak positively as to the exact proportion borne by the fractures of the acromion to the other fractures which I found, my strong impression is that *they largely exceeded in number those of any other bone in the body*. Yet I find in the same article in Holmes's 'System,' page 953, the following statement: "The frequency of fracture of the acromion process has been over-rated, as many of the numerous specimens found in museums of what at first sight appear to be old ununited fracture of the acromion are *probably examples of non-union of the epiphysis*." This bold assertion is based on the authority of Hamilton's work, to which reference is made. On looking up the grounds on which Hamilton formulated his hypothesis of separation of the epiphysis I found no argument or reason to lead one to suspect the possibility of their being what he speaks of[1] as "merely a separation of the epiphysis, the bony union having never been completed." What does he mean by this? Does he wish one to suppose, as one would naturally, that the epiphysis had been separated by force, using the phrase *separation of the epiphysis* in its usual acceptation, or does he mean that the cartilage intervening between the two fragments undergoes fibrillation in the same manner as does the cartilage between the manubrium and gladiolus? Against the second possibility which I have suggested, namely, that the bony centre in the extremity of the epiphysis has formed with the remainder of the bone an arthrodial or amphiarthrodial joint, as in the manubrio-sternal articulation and in the joint which usually exists between the body and cornua

[1] 'A Treatise on Fractures and Dislocations,' p. 244, F. H. Hamilton.

of the hyoid bone, I would put forward the following arguments:

1. The frequency with which it occurs associated with other fractures of the shoulder-girdle and its connections, where it is extremely probable, if not absolutely certain, that it owed its presence to the same cause. In some of these cases an amphiarthrodial joint, with or without displacement, is present, while in others an arthrodial joint, with or without forward, or forward and downward displacement exists.

2. The frequency of its association with so-called rheumatoid arthritis of the shoulder-joint, which I consider to be as much an expression of injury as fracture.

3. Its much greater frequency on the right side.

4. The broad limit in the space in which this condition is found. It may occur outside the clavicular facet or a considerable way inside.

5. The variation in the direction of the fracture with respect to the axis of the acromion.

6. The fact that the seats of this condition and those of fracture artificially produced differ in no single particular.

He, however, suggests *the former possibility*, for in the next sentence he goes on to say, that "if such fractures or separations occurred only in children, very little doubt might remain as to the general character of the accident; but the specimens which I have found in the museums and the cases reported in the books have been mostly in adults." Surely one can only draw one conclusion from this statement, but he then continues: "It is very probable also that in the case of many of the specimens found in the museums called fractures, the histories of which are unknown, they were united originally by cartilage, and that in the process of boiling or of maceration the disjunction has been completed. The narrow crest of elevated bone which frequently surrounds the process at the point of separation, and which Malgaigne may have mistaken for callus, is found upon *very many examples of undoubted epiphysial separations* which I have examined; and this circumstance no doubt has tended to strengthen the suspicion that these were cases of fracture."

I cannot understand anyone who has examined a bone from a young subject in which the cartilage uniting the epiphysis has

been removed by maceration, confusing this condition with the conditions presented by an ununited fracture of the acromion. The italics in the above quotation are mine. I should like very much to know what bones they were whose epiphyses had been so frequently separated from the shaft and had formed false joints with them, or, if the scapula is the only bone referred to, how it was ascertained that they were *undoubted epiphysial separations*, and also in what particular the narrow crest of elevated bone, when present in cases of separation of the epiphysis, differs from the similar marginal deposit in arthrodial joints following a fracture of the acromial end of the clavicle or first rib. Hamilton concludes that "*there is no doubt* that fracture of the acromion process *occasionally* takes place."

I think it must be quite apparent how utterly without foundation is Hamilton's hypothesis of separation of the epiphysis, and I have discussed the question fully in detail, for the reason that it has got into English works on surgery, and it will continue to be copied from one to the other. I would protest very strongly against the habit of copying material from other authors without verifying it, since the very fact of its being copied suggests that it has been verified.

In the same article I found in the statistics of the fractures treated at the Middlesex Hospital during ten years ending 1879, ten fractures of the acromion process in a total of 1084 fractures of all kinds. Of these ten one occurred during the first five years of life, one between fifteen and thirty, four between thirty and forty-five, and the remaining four in patients above forty-five.

These facts, taken in conjunction with the frequency with which this fracture is observed in the dissecting room, and the facility with which it is artificially produced in the dead subject, serve to show *that in the living subject fractures of the acromion process are hardly ever diagnosed.*

There is something radically wrong in our method of determining the relative frequency of fractures solely by our clinical experience. It is an extraordinary fact that I have not found one instance of fracture of the shaft of the radius or ulna, or of the inner half of the clavicle amongst all the bodies I have examined in the dissecting room. It is possible that a lapse

of many years may have removed all traces of a fracture during early life; still the fact speaks for itself, and as we proceed with the analysis of specimens we may form our own views on the reasons of the differences between results obtained clinically and pathologically.

The forward displacement of the fragment when the fracture occurs outside or through the anterior portion of the clavicular facet is due to the gradual contraction of the coraco-acromial ligament which draws it downwards and forwards.

I will now consider the fractures of the clavicle which I have found, and as I said before, during the last few years I have not seen one instance of united fracture of that portion of the clavicle which extends from its inner extremity to within half an inch of the conoid tubercle. I have, however, seen a considerable number of instances of fractures of the clavicle at or outside the conoid tubercle. I will describe a few examples of them.

A. Fracture of clavicle just outside conoid tubercle. Fragments united by fibrous tissue, which is dense and abundant. The outer fragment joins the inner fragment at a right angle, its outer extremity being displaced forwards.

B. Fracture of clavicle midway between conoid tubercle and outer extremity. Bones generally very thick and dense. Opposing surfaces of fragments eburnated and surrounded by a strong fibrous capsule. The outer fragment slopes more downwards and forwards than normal.

C. Fracture of clavicle through conoid tubercle. Almost all the conoid ligament is attached to the outer fragment, but a portion of the ligament appears to be attached to the extremity of the inner fragment also. The outer fragment is displaced nearly horizontally below the inner, for the whole depth of the clavicle, and it is united to the inner fragment by bone. It joins the inner fragment at an angle approaching a right angle.

I might add several more instances of fracture of this portion of the bone. It will be seen that the displacement and seat of fracture bear out the conclusions we arrived at hypothetically and experimentally. I find stated in the article in Holmes's 'System' already referred to, that out of 412 fractures of the clavicle treated at the Middlesex Hospital, ten were instances

of fractures of the acromial end, and out of the total of 412, 365 occurred in subjects over thirty years of age. *It is clear that fractures of the acromial end of the clavicle are not always diagnosed, and it is probable that the propinquity of the acromio-clavicular articulation and comparatively slight displacement assist materially in their being frequently overlooked.*

Fractures of the Sternum Alone.

I will now proceed to describe specimens of fracture of the sternum alone that I have found in the dissecting room, and in doing so I will only use those specimens in which there could be no possible doubt as to the existence of fracture.

I showed theoretically and experimentally that the sternum alone yields much more readily when the manubrium is united to the gladiolus by bone than when an articulation exists between these bones, and pathological experience confirms this.

The first case was in a male subject in whom the manubrium was fused to the gladiolus. The gladiolus had been fractured between the attachments of the second and third costal cartilages where the bone was very narrow. The line of fracture extended somewhat obliquely downwards and to the left, and its position was indicated by an elevated mound of bone on both the anterior and posterior surfaces of the sternum. There was no displacement of fragments. The manubrium was very short and relatively broad.

The first costal cartilage presented but slight osseous change, and there was present in the inner portion of each the amphiarthrodial joint which I have shown to be usually present in the unaltered first cartilages of sterna which contain no manubrio-gladiolar articulation, and whose function is evident from the facts we have already discussed. There was no fracture of any other bones.

The second case is an extremely rare one, as it is the only *pathological* specimen I can find of ununited fracture of the sternum. I obtained it from the body of a female subject. The first costal cartilage had not undergone any osseous change. The right second cartilage articulated with the

sternum at a level three quarters of an inch below its fellow. This was the only instance of costal asymmetry present. The line of union of the manubrium and gladiolus was consequently a little oblique, and was indicated as usual by a slight ridge on both aspects of the sternum. It ran from the centre of the inner extremity of the right second cartilage to the corresponding part of the left second cartilage.

The direction of the fracture was obliquely downwards and to the left, running through the manubrium from its right margin three quarters of an inch above the right second chondro-sternal articulation to the left margin at the level of the upper border of the left second chondro-sternal articulation. The opposing surfaces of the bones were covered by cartilage and were united to one another by a strong fibrous capsule which allowed of free movement in this acquired arthrodial articulation. The upper extremity of the lower fragment presented considerable irregularity on both aspects, especially on the posterior, and this irregularity was evidently the remains of a comminution or chipping of the bone at the time of the injury. The upper fragment showed the same irregularity, but to a less degree. These fragments of the sternum had evidently been acted upon by the forces which determine the presence of the manubrio-gladiolar articulation, but which originally failed to produce it in this subject. This case, therefore, supports the hypothesis that the manubrio-sternal articulation has for its chief factor the leverage action of the clavicle upon the manubrium and first costal cartilage.

Gurlt has collected three *clinical* instances of ununited fracture of the sternum in his work on fracture, 'Hand. d. Lehr. v. d. Knockenb.,' vol. ii, p. 304.

The *first* of these (Case 30) was published in the 'London Medical Journal,' vol. viii, 1787, p. 391. The gladiolus had been fractured. Suppuration followed later, and a piece of bone came away from the lower fragment. The ends of the bones were seen to be united by ligamentous tissue. As the patient recovered full power afterwards bony union may or may not have taken place later.

The *second* (Case 56) ('Annalen des königl. klin. Instituts am St. Jacob's Hospital in Leipzig,' Leipzig, 1810, Bd. i, Abth. i, 5, 124) was an oblique fracture of the xiphoid cartilage

in a man sixty years old. Nine months after the injury the lower fragment was freely movable, and crepitation was felt on movement. This last fact appears to be rather extraordinary. This specimen hardly deserves to be classified as an ununited fracture of the sternum.

The *third* case (Case 71) is so briefly described that I do not think the description contains sufficient grounds to define it as an instance of ununited fracture.

In a third subject I found the sternum had been fractured just below the articulation of the second costal cartilages with the sternum. In this case the manubrium was united to the gladiolus by bone, and the first costal cartilages presented no sign of fracture. There was no displacement of fragments, but a slight transverse ridge indicated its position. I have unfortunately mislaid the notes of this specimen, and do not remember whether the subject was a man or a woman.

Fractures of the Sternum and First Costal Cartilages.

I will now describe those instances of fracture of the sternum and first costal cartilages which I have found.

The first specimen I took from the body of a powerfully-built male subject. The broad lower extremity of the manubrium was united to the gladiolus by a narrow layer of dense ligamentous tissue which allowed of but very slight movement between the bones.

The manubrium had been fractured immediately above this articulation, and the lower margin of the upper fragment (which was formed by the lower margin of the manubrium) projected forwards a little in front of the lower fragment, and on the posterior surface of the bone there was a little higher up a corresponding depression, owing to the fracture having run somewhat obliquely downwards and forwards.

Fig. 21 shows the appearance presented by the front of the specimen. The drawing hardly gives one so good a representation of the fracture as did a vertical median section, since it does not show the forward projection of the lower margin of the manubrium. It shows, however, the remains of the chipping of the fragments. In this case the bone of the manu-



FIG. 21.

brium had yielded instead of the ligamentous tissue uniting it to the gladiolus.

Both first costal cartilages were sheathed in a thick bony callus extending on the left side outwards from the manubrium over the cartilage as far as the rib, producing an appearance quite distinct from that presented by the ordinary ossified cartilage. On making a vertical transverse section through the left first cartilage the sheathed cartilaginous core was seen to present near the manubrium an unusual amount of ossification, and the appearances presented lead me to conclude that this cartilage had been broken through, partly or completely, near its attachment to the sternum.

The right first cartilage presented the same extension of bone from the manubrium, but the chief mass of bone was situated near its outer extremity below. A delicate serrated line was seen to cross this prominence obliquely from within, downwards and outwards, and a certain amount of movement could be obtained at this point. This appearance of the cartilage differed entirely in appearance from the joint which as I have shown develops in the ossified cartilage, and which I have described on p. 394, and figured in figs. 2, 3, 4, 5, and

6, Plate VI. This distinction is seen even better on examining a vertical transverse section of this cartilage and the manubrium.

Fig. 22 represents the posterior aspect of the anterior portion of the fractured cartilage, the right end of the drawing corresponding to the inner extremity of the rib around which the bony callus of the fracture is seen to pass. (This is also seen in Fig. 21.) The left end of the drawing represents a portion of the manubrium which has been removed obliquely.

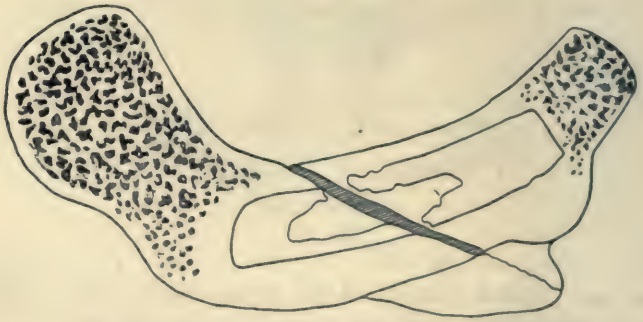


FIG. 22.—Ununited fracture of right first costal cartilage.

The rigid cartilage contains no sign of the presence of the joint which usually develops in it, showing that the injury must have taken place during comparatively early vigorous adult life.

The fracture is seen to be ununited, the ends of the fragments being connected by a thin intervening layer of dense fibrous tissue.

The sheathing of the cartilaginous core is very thick and remarkably dense. I have endeavoured to show this in my drawing. The cartilage on each side of the fracture has been converted into bone in a somewhat irregular manner, so that the cartilaginous surfaces are only connected to one another indirectly at one or two points in the margin of the core.

The fracture has passed obliquely from within downwards and outwards through the centre, or rather just inside the centre of the cartilage. The large boss of bone projects from the lower and anterior surface of the fracture, so that it lies

in front of this section. On making a section of it, the intervening connectant fibrous tissue is seen to be even more scanty than elsewhere. The forces which normally cause the development of a joint in the ossified cartilage had in this case so influenced the fracture as to prevent its union by bone, and to produce an amphiarthrodial joint. The seats and the lines of the fractures in this specimen correspond with those I obtained experimentally, and they have evidently resulted from a heavy blow applied vertically to the shoulder. There was no fracture of any other bone.

The second case is very similar to the last. It is figured in fig. 1, Plate VI. It was obtained from a male subject in the dissecting room. Both first costal cartilages had evidently been fractured at a point about half an inch from the margin of the manubrium. The seats of the fractures were indicated by the presence of irregular masses of bone which covered in the cartilage below, in front and behind, those surrounding the left cartilage being more abundant than those on the right side.

The right cartilage, which on section was seen to be completely sheathed in bone, and therefore nearly rigid, contained two amphiarthrodial joints, one in the usual position, namely, half an inch from the outer extremity of the cartilage, and the other about its centre. There was only one on the left side in the normal position. This one allowed of free movement. Whether the fractures through these cartilages were complete or not it would be difficult to say. The extent of the fracture was, however, sufficient to necessitate its being supported by much dense callus. The fracture of the first cartilage had evidently taken place during early vigorous adult life, before the cartilages had undergone much, if any, osseous change. The anterior extremities of the second and third ribs on the left side had been dislocated forwards from the outer end of their cartilages. The extremity of each rib retained a thin covering of cartilage, showing the condition to be one of fracture of the outer portion of the cartilage, rather than one of separation of the cartilage from the bone. The displaced fragments overlapped very slightly. They were connected to one another by bone, which filled in the angular interval between the overlapping ends and between the

surfaces in immediate contact. Processes of this bone projected upwards and downwards to the adjacent costo-chondral articulations, to which they were connected in the recent state by dense ligamentous tissue. The pleura over this area was thick and cartilaginous. The fourth left costo-chondral articulation was sheathed by a bony callus, and the third left chondro-sternal articulation was surrounded in a similar manner and to a greater extent. Both these cartilages had been fractured, but there had been no displacement of the fractured ends. I hope to show later that these fractures of the costal cartilages not accompanied by displacement are not at all uncommon. I have found several in bodies in the dissecting room. While discussing the mode of union of costal cartilages after fracture unaccompanied by displacement, or accompanied by displacement, the fragments overlapping very slightly, I would point out that when fracture of a costal cartilage is followed by considerable riding of the fragments upon one another the angular intervals are filled in by bone, while the opposing surfaces of cartilage are retained in contact by a thin layer of dense fibrous tissue, as I have shown in Fig. 23, which represents a transverse section of such a frac-

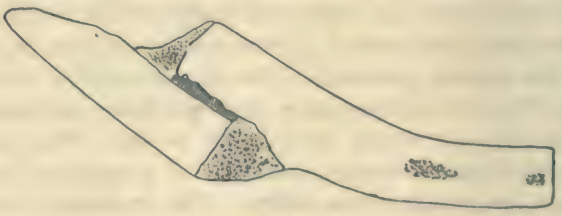


Fig. 23.

ture through the seventh costal cartilage on the left side. (In this specimen it is seen that the ends of the cartilage have undergone no osseous change.) The eighth cartilage was also fractured, and the fragments similarly displaced and united.

The sternum had been broken transversely at the junction of the manubrium and gladiolus, which had been united to one another by bone. The seat of the fracture was indicated by a circular boss of bone on the posterior aspect of the sternum between the articulations of the second costal cartilages with

the bone. Its surface was irregular and its diameter was about three quarters of an inch. On the anterior surface and sides of the sternum the line of fracture could be traced distinctly. There was no displacement of fragments.

This injury differs in no way from the conditions we arrived at theoretically and experimentally. It is evident that the left shoulder was struck by a heavy weight applied vertically. The clavicle had not yielded, but by its powerful action as a lever it fractured the sternum and both costal cartilages. It then pressed directly upon the second rib, fracturing and displacing its cartilage. It was after this able to exert a direct pressure upon the third rib and in a similar manner fractured and displaced its cartilage. It was forced still further downwards and caused the fracture of the fourth costal cartilage.

Fractures of the First Rib or First Costal Cartilage alone.

As I have said before, it is most difficult to ascertain the number of fractures of the first costal cartilage that take place, for the reason that in labourers as the cartilage becomes ossified and as a joint develops in it, it presents a very variable appearance. I am convinced, though these circumstances would appear to render it impossible for me to prove it at present, that *fracture of the first costal cartilage alone or associated with fracture of the sternum or first rib, is much more common than even my specimens will show it to be.* Experimentally, I have found that the ossified cartilage is fractured much more readily than the elastic unossified cartilage, which bends under pressure, and that the presence of an arthrodial joint does not save the rigid cartilage from fracture when the force transmitted to it is great and acts vertically on the outer end of the clavicle. Consequently it is much easier to determine the existence of a fracture of the cartilage, if it has been broken before it has commenced to undergo osseous change (which is probably the rarer condition), than if it has been fractured subsequent to its ossification. It will be noticed in examining the descriptions of my specimens that they almost all belong to the first class. Therefore they can-

not represent the total number of fractures of the first cartilages present among the total number of subjects I examined. The other circumstances which assist in obscuring the pre-existence of fracture of an ossified cartilage are that it usually breaks near the sternum, that the fracture is often incomplete, and that there is no displacement of fragments.

The *first specimen* is one of ununited or rather incompletely united fracture of the first right costal cartilage. I obtained it from the body of a powerfully built man, whose osseous system was dense and well developed. The outer span of either first rib measured $2\frac{3}{4}$ inches. The left first costal cartilage had undergone but slight osseous change. The right one had been fractured about $\frac{1}{8}$ inch from its outer extremity. The fracture was surrounded below, in front, and behind, by an abundant callus, which extended outwards so as to cover the anterior extremity of the rib. On removing the callus and separating the fragments, which was done by cutting through the scanty but firm fibrous tissue uniting them, the opposing surfaces of the cartilage presented no distinct osseous change, but were irregular. There was no indication of the presence of any synovial cavity. The reason the callus is collected around the lower part of the fracture is apparent when the force causing the fracture and that exerted upon it continually are considered. The line of fracture was not transverse. It extended obliquely downwards and outwards, and was somewhat irregular in outline. The articulation between the manubrium and gladiolus was loose and allowed free movement of the former bone upon the latter. It contained an articular cavity. There was no fracture of any other bone or cartilage.

The subject displayed very well a condition I have described in the earlier part of this paper, namely, the condition of difference in length of cartilages that were arranged symmetrically. In this subject the right second costal cartilage exceeded its fellow on the left side by half an inch, while the other cartilages were equal in length.

I have observed three indisputable cases of fracture of the first rib alone. They all occurred on the right side.

Two are published in a paper on the "Mode of Fracture of the First Rib Alone," page 327, 'Trans. Path. Soc.,' 1885, to which

I would refer the reader for detailed accounts of them. The first was ununited and was situated an inch and a quarter external to the tubercle. There was but slight displacement of the fragments. In the second case the fracture was ununited, forming a complete arthrodial joint. It corresponded in position to the groove for the subclavian artery. Since I wrote that paper I found that the costal cartilage of this rib had been broken at a point half an inch from its outer extremity, and that the opposing surfaces of the cartilaginous core had been united by bone. Surrounding this fractured core was a dense callus, which presented an irregular obliquely placed serrated suture.

The third fracture was a united fracture. The right first rib of a male subject had been fractured obliquely in a direction from before backwards in the seat of insertion of the scalenus medius. There was slight but distinct displacement of the fragments.

Besides these cases I have seen many first ribs which I thought had probably been fractured, but in which the displacement of the fragments was not sufficient to render the condition absolutely certain. This is what one would have expected from the nature of the artificially produced fractures of the first rib.

Besides these pathological instances of fracture of the first costal cartilage, I have these three examples in the living subject. In the two first, which were both in men, the costal cartilage had been fractured during late adult life by a heavy blow on the shoulder. In one the left cartilage was broken, and in the other the right. They had yielded close to the sternum, and the seat of fracture was indicated by a prominent mass of callus.

For the third case, I am indebted to Dr. Hale White. The man came to his out-patients, complaining of pain in and behind the upper part of the sternum and in the seat of the first costal cartilages, and inability to raise a moderately heavy weight owing to the severe pain he experienced in the above position on doing so. It had resulted from a fall off a ladder, the man striking his back and left shoulder against the ground. Dr. Hale White, knowing that I was particularly interested in this form of fracture, very kindly called my attention to the case.

The left first costal cartilage had evidently been broken close to the sternum, and a large irregular mass of callus indicated the seat of fracture. There was some bossing over the corresponding portion of the right first cartilage, but much less than on the left side.

On getting the patient to raise a heavy weight with his left arm he immediately complained of severe pain in both these cartilages, but especially in the left. He also complained of pain in the sternum at a point just above the level of the second costal cartilages. This pain, on depressing either clavicle, was very much more severe immediately after the accident, but though some months had elapsed it was still sufficiently acute to prevent his performing any hard work.

I think that there can be little or no doubt that the leverage exerted by the clavicle fractured the first cartilage on both sides, the left being more completely fractured than the right; also that the manubrium had been broken transversely in the immediate vicinity of the manubrio-gladiolar articulation. I was, however, unable to distinguish any prominence or irregularity on the anterior surface of the sternum in the supposed seat of fracture. My pathological and experimental experience would show that the absence of any prominence on the anterior surface of the sternum in the seat of fracture is not unusual.

It is quite obvious that it is necessary to treat a case of fracture of the first costal cartilage with as much care as fracture of any bone, and that the fragments can be best kept at rest by removing the weight of the arm.

Published Cases and Museum Specimens of Fracture of the First Rib or its Cartilage.

I can only find one instance of fracture of the first costal cartilage published, and, curiously enough, I think that there is no doubt that it was not an example of fracture of this cartilage, but an instance of dislocation of the joint, which I have shown is developed in the ossified first costal cartilage, and which was not recognised at that time.

The case I refer to is one published by Dr. Bennett in the

'Dublin Quarterly Review,' March, 1876. A man who was covered by a falling mine, had nearly all his long bones broken and all of his right and many of his left ribs. The fibro-cartilage uniting the manubrium and gladiolus was torn through and both first costal cartilages were fractured.

The left first costal cartilage *was fractured perfectly transversely* at its outer extremity, leaving a small scale of cartilage filling the normal hollow in the end of the rib.

The right first cartilage *was fractured transversely* about its centre.

Both first costal cartilages were extensively ossified, the left completely so. In all the experiments I have made *I have never seen the ossified first costal cartilage fracture transversely but irregularly,* as one would naturally expect in a structure of this sort. I would refer the reader to Figs. 2 to 6, Plate II, where I think he will find the condition described by Dr. Bennett, and will conclude that his specimen was not one of fracture of the ossified cartilage, but a *true dislocation of the amphiarthrodial or arthrodial joint in the ossified left first costal cartilage.* I believe the so-called fracture of the right first cartilage was also a dislocation of this joint.

Dr. Bennett attributed the rupture of the ligamentous tissue connecting the manubrium to the gladiolus to force acting directly upon the manubrium. I think, however, that circumstances point rather to the leverage action of the clavicles upon the manubrium and first cartilages as the chief if not the sole factor in its production.

In the museum of Guy's Hospital there is a specimen, No. 1292[30], of fracture of the ossified first costal cartilage. The inner end of the clavicle has been dislocated upwards and the ligaments binding it down are ruptured. The sternum is intact. The first costal cartilage on the right side has been fractured through a point about half an inch from the sternum. As it had previously undergone extensive osseous change the line of fracture does not run vertically or obliquely with a plane surface as it does in unossified cartilage, but it was very irregularly oblique, the opposing surfaces of the fractured cartilage being also very irregular. This fracture was evidently the result of force applied vertically to the outer end of the clavicle. The appearance and seat of the fracture

of the ossified cartilage are identical with the condition I have usually obtained by fracturing it artificially.

I can find only one published instance of fracture of the first rib, and I would refer the reader to Mr. Lyell's article on "Injuries of the Chest," in Holmes's 'System,' for the brief description of the case. I think the reader will agree with me when I say that the number of published cases of the fractures I have described in this paper do not accurately represent their relative frequency.

I hope to follow up many of the points contained in this paper, and to continue the subject in a subsequent number of the 'Guy's Hospital Reports.' Want of space has prevented me from discussing in detail several important questions in this paper.

CYSTIC TUMOURS OF THE BREAST.

By THOMAS BRYANT.

Under this heading I propose to group all tumours of the mammary glands made up of cysts, whether those cysts are multiple or single, whether they contain fluid alone or are more or less filled with adeno-fibromatous, adeno-sarcomatous, or adeno-carcinomatous intracystic growths.

I shall not stop to inquire into the different methods by which the cysts are formed, since I believe it to be impossible *clinically* to make out, otherwise than in exceptional cases, whether the cysts are due to an obstruction of a galactophorous main or branch duct (retention cyst); or to the exudation of fluid into the intercellular spaces of the connective tissue of the breast (lacunar cysts); or to the growth of papules into a duct or acinus from the connective tissue of the breast and their subsequent junction. Neither can the surgeon speak with certainty in all cases as to the absence or presence of an intracystic growth nor as to the nature of the growth.

In a large proportion of cases in which the cyst contains solid growths a diagnosis of its nature can, however, be made, but the diagnosis is then more determined by signs and symptoms other than those associated with the presence of a cyst. To these points attention will be drawn later on.

I would, however, for the sake of convenience and possibly of clearness, divide the subject up into certain sections, and consider:

1st. The cystic degenerations of the breast as met with in the

old, as well as in glands which have long ceased to be active (involution cysts as they are called).

2nd. Cystic tumours of the gland, single or multiple, of glandular, duct, or connective-tissue formation *without* intracystic growths.

And, 3rdly, cystic tumours of the breast of whatever kind in which papillomatous, adenomatous, sarcomatous, or carcinomatous intracystic growths are present.

These three classes will be considered in order.

Group I.—*The cystic degeneration of the gland as met with either in the old or obsolete gland.*

This condition must without doubt be recognised, for it is found in the breasts either of the old or of those in which the glands have ceased to be active and are, as it were, undergoing involution changes.

It may be that a single lobe or lobule is undergoing this special form of degeneration, but more probably the change will have affected the whole gland, which on dissection will be found to be made up of innumerable small cysts, varying from the size of a hemp-seed—the more common size—to that of a pea, whilst in exceptional cases these dimensions, in isolated cysts, may be considerably exceeded.

The cysts appear more as a series of dilatations of the lactiferous ducts (varicose ducts) than of the gland structure, although in certain cases both ducts and gland structure are involved.

On dissecting these cases and on separating the ducts, or rather unravelling them, the gland as a whole may be involved, and in a dissection I made many years ago the breast appeared, when suspended by the nipple, to be made up of strings of small cysts connected together by the main and branch ducts. Some of the cysts had direct tubular communication with the neighbouring cysts, as proved by the passage of bristles through the ducts from one cyst to another, or by the fact that many of the cysts and ducts could be inflated by means of a fine tube introduced into one or other of the nipple-ducts. In many cases, however, this direct communication cannot be made out.

These cysts when unopened have usually a greenish or black appearance, and when opened they are found to contain a blackish viscid or mucoid fluid, more or less coagulable by heat, and mixed at times with fat and epithelial elements, such being the products of degenerating epithelium.

The breast, thus affected, feels on manipulation in thin subjects as a coarse gland, with here and there a pea-like tumour, whilst in fat women the change often cannot be clini cally recognised.

This change is rarely associated with pain, or with a greater amount than can be described as uneasiness. There is seldom any discharge from the nipple in these cases although there may be at times. Why there should not be a discharge always can only be explained by the fact that the ducts become obstructed, and probably by their epithelial elements.

In exceptional cases some enlargement takes place of a single cyst or group of cysts, and under such circumstances a cystic tumour is formed, for which surgical advice is sought. I have seen many of these cases. In some the cyst was single and relief was given by simply drawing off the fluid by means of a small trocar and cannula; in other cases two or more cysts existed; in a few they were still more numerous and showed signs of activity, so that excision of the affected lobule or whole gland was required.

In not a few cases the cysts have become the seat of intra-cystic growths, sarcomatous (Case 30), adenomatous (Cases 17, 18, and 19), or cancerous (Case 33), for which extirpation of the whole gland has been necessary. To these attention will be drawn later on.

What I would wish now to be recognised is the fact that there is in the mammary glands which have long ceased to be active, and in those of women past child-bearing, a cystic degeneration of their ducts and glandular structure which may simply remain as such or take on active changes. Under the latter circumstances a cyst or many cysts may either enlarge so as mechanically to cause trouble or become the seat of intracystic, adenomatous, sarcomatous, or carcinomatous growth which will run the usual course of such tumours.

GROUP II.—*Cystic tumours of the gland—single or multiple—of glandular, duct, or connective-tissue formation without intracystic growths.*

That these are not uncommon in practice must be fully recognised, although it must be acknowledged that they are too often not diagnosed until by some error they have been subjected to surgical operative treatment, when their true nature has been made manifest.

I take it, few surgeons have been so fortunate as not to have removed a breast for a supposed cancer which turned out to be a cyst; and fewer still who have not, as spectators of such a case, been well sprinkled with the fluid of a tense cyst accidentally opened by the hand of a surgeon in his attempt to cut into or excise what he regarded as a solid tumour.

Formation of cysts.—These cysts are doubtless developed in several ways. Some are unquestionably "*duct-cysts*," that is, they are formed first by an obstructed and subsequently by a dilated irritated duct, the duct being more commonly a branch than a main duct, and occasionally a duct leading directly into an acinus of the gland. When the branch is a large one the cyst is likely to be single; when it is placed nearer the gland structure the cysts are more likely to be numerous. The cystic tumour in the former case appears as a globular, tense, more or less deeply placed growth; and in the latter as an unequal enlargement of one of the lobules of the gland, with a more or less bossy outline and semi-fluctuating feel; this latter symptom turning much upon the size the cysts attain and the depth of gland structure which covers them in.

The fluid contained by these cysts varies much. In the majority of cases it is clear and serous, in others it will be brown or slightly blood stained, in a few cases it will be viscid and mucoid. When it is deeply blood stained or sanguineous the surgeon should suspect that it is not a simple but a proliferating cyst in which some intracystic growth exists. In almost all cases the fluid will be albuminous, at any rate, I have not yet met with an example in which it was otherwise. At times fluid may escape naturally or may be pressed from the nipple, and when this takes place the diagnosis of a duct or glandular cyst may with confidence be made. In half the cases of this affec-

tion no such symptom will, however, be found, but this fact need not diminish the value of the symptom for diagnostic purposes when it is present.

Others of the cysts have a "*connective-tissue origin.*" That is they originate outside the ducts of the gland or the gland structure and are formed by the effusion of fluid into the connective tissue which binds the lobes and lobules of the gland together. Such cases are usually single but may be multiple. They are commonly of slow formation and as a result have thick walls. They are always smooth on their inner surface, and as a rule contain serous fluid. At times the fluid is, however, mucoid or dark. When the cyst appears in the breast of a thin woman its tense globular outline, unassociated with any of the symptoms which are recognised as characterising the existence of a cancerous or other tumour, should suggest its nature as well as treatment, for the puncture of the swelling with a fine aspirating needle will prove much.

When the cyst shows itself in the breast of a fat subject the diagnosis must be difficult, but its true nature should ever be suspected, even when all other symptoms of more solid growths have by the lapse of time failed to manifest themselves. The more breast tissue there is to surround a cyst or cystic tumour the greater the difficulty of diagnosis. The longer the tumour has existed without the manifestation of the well-recognised symptoms of cancer or other growth the stronger the probability of its being cystic. In all doubtful cases, however, the fine exploring needle of an aspirating syringe will avail much for diagnostic purposes. In but few of these cases can the surgeon without exploration diagnose between the simple cyst and the cyst with proliferating intracystic growth. Simple cysts of the breast exist and in many cases never develop into anything else or become the seat of solid growth. With the majority of cystic tumours this, however, is not the case, for what may seem to be the most simple or innocuous cyst may be expected, if not cured, to become the seat of some proliferating intracystic growth, which will be adenomatous, sarcomatous, or carcinomatous, according to the tendency of the tissue to form and of the individual to develop either special variety.

The mere presence of a cyst in the mammary gland must be

accepted as evidence of some unnatural local irritation, inflammatory or otherwise, whether that irritation has originated in, or become localised about, a gland-duct, lobule of gland, or connective tissue. If the irritation is subdued or subsides, a cure or at any rate no fresh development of the local trouble may be looked for; but should the local irritation continue or intensify, fresh developments must be expected, and such of necessity will assume the form of a new growth either of the glandular, epithelial, or connective-tissue type, and lead on to the formation of an adenomatous, epitheliomatous, or sarcomatous cystic growth, to which attention will now be drawn. In rare cases the cyst will suppurate and undergo a spontaneous cure (Case 5).

GROUP III.—*Cystic tumours of the breast of whatever kind in which papillomatous, adenomatous, sarcomatous, or carcinomatous intracystic growths are present.*

If, clinically, simple cystic tumours of the breast are fairly common, pathologically they must be pronounced to be comparatively rare, for it is, I think, indisputable that in the majority of cystic tumours of the breast, of whatever character, of duct-cysts, gland-cysts, or connective-tissue cysts, some solid element can usually be found proliferating from their lining walls, either in the shape of a small sessile or pedunculated outgrowth or of a solid tumour composed of glandular, epithelial, or connective-tissue elements; the nature of the growth being determined by the seat and persistency of the local source of irritation which originated the formation of the cyst. When the cyst is single the growth will of necessity involve it alone. When multiple some of the cysts may be simple or non-proliferating while others are proliferating; the association of the two kinds in the same gland being not uncommon. The surgeon consequently meets with cystic tumours of the breast in which in one case *papillomatous growths* are present; the papilloma being a simple outgrowth of the cyst wall in the same way as the same growth may spring from the nipple or other structure. Whilst in another case the cyst may have an *adenoid growth* hanging or springing from its walls, the growth appearing either as a pedunculated intracystic growth washed

with the cyst contents, or the cyst may be filled with sarcomatous or adenoid tissue either of a loose or more solid structure; the tumour in the latter case, when the cyst is full, losing much of its cystic character and approaching the more solid kind, whilst the intermediate conditions between these two extremes suggest and give support to the view which some pathologists entertain, that these solid adeno-sarcomatous or fibromatous tumours as a rule originate in cysts and only differ in the degree in which the cyst cavity is filled.

In many cases doubtless what appears to be an intracystic growth is nothing more than a growth originating in the connective or glandular structure outside the cyst but projecting into it, and having its surface bathed with fluid, the fluid being either the secretion of the cyst wall or an exudation from the growth itself into the cyst cavity. The same remarks are also applicable to sarcomatous and carcinomatous tumours, for without doubt a large number of those beginning as cystic tumours of the breast pass on to become sarcomatous and carcinomatous; the connective-tissue element in the former case and the epithelial element in the latter so increasing and filling what was at one time simply a cyst or cysts as clinically to form what is now known as a cystic sarcomatous, cystic adenomatous, or cystic carcinomatous tumour; the three varieties in the cystic disease maintaining the same clinical features that characterise the more solid kinds, the symptoms of the solid and the cystic being the same in each, with the addition in the latter of the cyst element. The diagnosis of a cystic adenoma, cystic adenofibroma, sarcoma, or carcinoma is consequently to be determined by the same points as are known to characterise a solid adenofibroma, adenoma, adeno-sarcoma, or carcinoma, with the addition of such clinical symptoms as are clearly referable to the existence of cysts.

Diagnosis of Cystic Tumours.

In the examination of every tumour of the breast, and particularly of one in a woman over thirty-five, the surgeon as a matter of habit should allow the possibility of the case having a cystic origin to pass before his mind. By so doing he will

not only prevent errors of practice which may be grievous, but at the same time he will guard against sources of serious mortification, for, I take it, there are few things more humiliating to a surgeon than an error in practice based upon a wrong diagnosis, when the error is not due to the inherent difficulties of the case, but, to a want of care. When the tumour is in the breast of a woman over forty years of age this caution is more necessary, for cystic tumours of all kinds are more prone to occur in women over thirty-five and past the prime of life than in younger subjects. In 1861 I, however, removed a sero-cystic tumour from the breast of a girl aged twenty which had been growing for three years and at the time of operation measured twenty-two inches in circumference, and weighed after removal two and a half pounds. This preparation is preserved in the Guy's museum, prep. No. 2295, drawing 480^{20}, model 40^{10}, with another, marked 2297^{20}, in which a cystic-duct sarcoma of one and a half years' growth was removed from a girl aged fifteen. When the tumour seems part of the breast-gland itself and appears as a single or possibly double growth in one or more lobes of the gland; when the swelling is very hard and tense and is not the seat of pain even when handled; when it has existed for several years and has given rise to no other symptoms than such as are referable to its mechanical presence, the probabilities of the tumour being cystic are very great. When the swelling is bossy or botryoidal and fluctuation can be detected in some of its parts; when with the swelling there is a discharge from the nipple and this discharge can be increased by pressure or manipulation, the diagnosis of cystic disease is evident, and with the nipple discharge the diagnosis of a duct-cyst is clear.

Whether the cysts be simple or proliferous is another question, and if the latter, the nature of the growth they contain is still a third. In a general sense it may be said that a single cyst is more probably simple than when the cysts are multiple and form a polycystic tumour; that is, when a lobule of a gland is expanded by the presence of a single cyst that cyst is more likely to be of a simple kind than when the cystic disease has involved more of the lobule. Simple polycystic disease of the breast is a rare affection, except as a result of general glandular degeneration. When a discharge

from the nipple exists, and that discharge is bloody, the probabilities of a cyst containing some intracystic growth, however small, should be recognised, since it is from the vessels of the intracystic growth that the bleeding as a rule takes place. Simple cysts rarely bleed. When the bleeding is encouraged by or has followed manipulation, the probabilities of the cyst containing an intracystic growth are very great. When a cystic tumour exists in a lobule of the gland as a fluctuating swelling in some parts and a more solid one in others, the diagnosis of solid with cystic growth is tolerably clear; and when with this there is a free discharge of a bloody kind from the nipple, the diagnosis of cystic duct and glandular disease is highly probable. These lobular cystic tumours often present a somewhat typical shape, that of a pear the narrow part of which is represented by the nipple. Few of these tumours cause pain. Advice is sought as a rule either on account of the tumour or on account of the nipple discharge, not from pain.

The *diagnosis of a cystic adeno-fibroma or adeno-sarcoma* is to be made out by attention to the same points as help the diagnosis of these growths when uncomplicated with cysts. That is, a cystic adeno-fibromatous or sarcomatous growth simply troubles from its size or from its nipple discharge. By its growth it expands the integument over it and spreads out such portions of the breast-gland as may not be involved, but it in no other way involves its coverings. The skin may be stretched even to a rupture, but even then the skin as tissue will be neither invaded nor infiltrated with disease. The cysts themselves may even burst and discharge their contents externally, but under such circumstances the integument that fringes the edges of the ruptured orifice will still be seen free, and can be readily distinguished even from the extruded or extruding intracystic fungating contents (Case 23). The nipple may be so flattened out as nearly to be indistinguishable, but it will only in very exceptional cases (Case 22) be drawn in by the disease, as seen so frequently in cancer; and even should it be drawn in, inquiry will generally reveal the fact that such a condition was either congenital, or that some cicatrix of a former abscess had altered its normal shape. Should the cyst be, however, more central and separate the lactiferous ducts, nipple retraction is to be expected.

The lymphatic glands (axillary and clavicular) will rarely be involved; when they are they will be affected actively from lymphatic irritation rather than from lymphatic absorption, and under such circumstances the enlargement is more frequent when the cysts have burst through and irritated the skin than under other circumstances. In some forms of rapidly growing cystic sarcomatous as well as solid sarcomatous tumours, the lymphatic glands are, however, seriously affected.

The *diagnosis of cystic carcinoma* will turn upon the same points as that of the more common kind of cancer. Though the growth may have originated in a tube or cyst it will not long be confined within its capsule, for, obedient to its nature, it will invade its cyst walls (Cases 35, 36) and creep into the tissue outside; it will then spread into the neighbouring parts by the one marked way in which carcinomatous tumours locally spread, viz. by steady and progressive infiltration or local infection; the carcinoma in its progress having first infiltrated the cyst in which it originated, then the tissues outside the cyst, later on those which surround these, and last of all the integument itself; the infiltration of the integument first showing itself as a "dimpling" of the surface, next as a "puckering" of the skin, thirdly as an "infiltration" of the skin, and lastly as an ulceration. Should a cyst so enlarge as to encroach upon the skin and to infiltrate it and later on rupture through it, the intracystic carcinomatous growth will project and grow through the opening, but the edges of the orifice through which the intracystic growth projects will be found infiltrated, everted, and involved in the disease, and not, as described in the cases of cystic sarcoma, simply ruptured, the infiltrating tendency of the disease being marked in all its stages, from its first to its last. The intracystic growth will never project, and fungate in the way of sarcomatous growths. Should the nipple be affected by the disease, it may first be as a conduit for the discharge through the milk-ducts, but later on, when the disease has left the cyst and invaded the tissues outside its borders, it will be affected in other ways. When the tumour by its growth has drawn upon the suspensory ligaments of the gland and ducts of the nipple some retraction of the nipple will ensue, and later on, should the nipple itself become materially infiltrated, there may be actual projection. At times there may be such infil-

tration and contraction of the tissues around the base of the nipple as to produce œdema of it from blood stasis and in rarer cases even sloughing.

The lymphatic glands, axillary or clavicular, will become affected in the cystic form of carcinoma as they are known to be in the non-cystic kind, and they will be affected in the same way. In fact, the progress of a case of cystic carcinoma is similar in kind to that of the more solid form. At the beginning it may possibly be slower, but when the disease has extended beyond the cyst wall or walls I am disposed to think it is often more rapid.

Treatment of Cystic Disease of the Breast.

In all cases in which the true cystic nature of the tumour is doubtful an exploratory puncture with a small aspirating needle should be made, not only for diagnostic purposes, but with the reasonable prospect of retarding if not arresting the progress of the disease, and this hope may reasonably exist should the disease consist of the dilatation of a single duct, for I can recall not a few examples of what turned out to be simple serous cysts of the breast which had been tapped for diagnostic purposes in which after the lapse of years no return of the trouble has taken place (Cases 3, 4). When a simple tapping has proved ineffectual or is inapplicable, an incision into the cyst, its free drainage, and healing by granulation, may bring about a cure, but these means should only be adopted when the cysts on being incised have been found quite free from all signs of intracystic growths and the cyst is single (Cases 6, 7, 8, and 9). When more than one cyst exists in a lobe this treatment is hardly applicable, and the safer practice is to dissect out the cysts with enough of the surrounding gland to make it reasonably probable that the disease has been wholly removed (Case 11). When the cyst contains an intracystic growth it must be freely excised (Case 15), and should more than one such cyst be made out the whole gland had better be extirpated, for all proliferating cysts are prone to grow, and the breast-glands of such as contain them are rarely only locally implicated. I have on many occasions after the removal of a cystic sarcoma-

tous tumour found such portions of the gland as seemed to be healthy the seat of the same disease only in miniature, and this fact fairly suggests that the disease, although palpable in one part and apparently local, is really a general gland disease, and that under such circumstances the whole gland had better be excised.

In the more solid forms of cystic sarcoma and cystic carcinoma early excision is a rule of practice which should never be deviated from.

In exceptional cases a cyst inflames and suppurates; such should be treated as an ordinary abscess, by incision, antiseptic irrigation, and drainage (Case 5).

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3. Susan B—, æt. 24. Duct-cyst in breast; retracted nipple. Tapped and cured.
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14. Mrs. S—, æt. 39. Sero-cystic disease of breast; excision. Well eight years later.

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15. Mrs. D—, æt. 45. Cystic (duct) adenoma of breast; excision of lobe. Cured.
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22. Mrs. S—, æt. 50. Cystic spindle-celled sarcoma; retracted nipple; excision. Well eight years later.
23. Mrs. S—, æt. 71. Cystic spindle-celled sarcoma; rupture of cyst; hæmorrhage; excision. Cured.
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Cases.

Case 1. *Involution cysts of breast which had long ceased to be active, simulating cancer; excision of gland; recovery.*—Mrs. T—, æt. 52, the mother of many children, all of which she suckled, consulted me in May, 1885, for some affection of her right breast which had been slowly coming on for about six months. It began as an enlargement of the axillary lobe and later on as a swelling of the whole breast. At times there was a discharge of a clear fluid from the nipple and some slight pain.

When seen the whole breast was coarsely enlarged and indurated; one lobe, the axillary, seemed to be generally infiltrated with some new material; the other lobes were full of nodules which appeared to be cystic. The nipple was natural, but pressure upon the breast caused from it a slight discharge of a serous fluid. The skin over the breast was healthy, as were the lymphatic glands.

I regarded the case as one of carcinoma with cystic degeneration of the gland and advised excision.

On May 13th the operation was performed and a good recovery rapidly followed.

Description of breast by Mr. Symonds.—Just beneath the nipple was a cyst, one inch in diameter, with a thick dark wall, embedded in condensed breast tissue, containing many smaller

cysts. Everywhere through the breast these cysts existed, and all were filled with a creamy grey fluid, which exuded as so many beads when the breast was squeezed. The galactophorous ducts were filled with this same material, which exuded from the nipple on compression. The whole organ had a uniformly whitish-grey colour, but nowhere was any solid growth visible. The outline of the breast seemed also normal, and there was no infiltration of, or alteration in, the surrounding fat.

Microscopical examination.—The fluid was not examined fresh, but from its resemblance to that seen in similar cases, and from its appearance in the hardened sections, it no doubt was composed of degenerated cells and fatty granules.

The appearances seen in the sections might be shortly described as showing the ordinary breast tissue containing many cysts. There are groups of small tubes cut in various directions, some having a distinct lumen, many showing only a number of irregular cells. These groups are always surrounded by fibrous tissue containing fat vesicles and represent the ordinary breast lobules. The adipose tissue is in some places tolerably abundant. Many of these tubes are much enlarged, having a wide lumen, occupied in many instances by granular matter, and lined with two or more rows of cells. As the accumulation of secretion increases, the central aperture enlarges until a small cyst is formed visible to the naked eye. These changes are all obvious in the illustration (Plate I, fig. 1) and occur in all parts of the breast.

Besides these cysts with a round lumen there are many apertures with a sinuous outline, and many with villi or buds projecting towards the cavity. These are all lined with two or more rows of cells, the inner row being more or less columnar, and taking the stain (logwood) more deeply than the outer or irregular cells. The buds or projections are covered by the same cells and have vessels and fibrous tissue as a basis. The appearances are shown in the illustration.

Again, the largest cysts have a wall composed of lamellæ of fibrous tissue, are lined by large columnar cells, and contain some of the granular material above described. The cells form a definite layer much altered from the regular columnar shape by mutual compression; usually the layer is two cells thick, but there is no regularity in the arrangement. The

fibrous tissue seems no more in amount than that proper to the breast, the cyst formation appearing to be the only morbid change. From the description given above, and from the appearances presented in the drawing, these cysts all seem to form out of the mammary acini and ducts. It is to be noted, in reference to another specimen (Case 31, Plate I, fig. 3), that there are no cell-filled areas. The villi or papillæ projecting from the walls of many of the cavities, and seen especially in the ducts just below the nipple, have received various interpretations. They have been considered to be ingrowths or buds from the wall of the cyst—intracystic growths—this explanation considering the cyst the primary formation. They have also been looked upon as projections into the breast acini or ducts, of portions of a solid fibroma. This view is held by many.

I think, however, that it will be seen from the way in which the fat is disseminated through this specimen that we are not dealing with a solid growth. I mention this point as the drawing given by Cornil and Ranvier to illustrate a "budding fibroma of the breast" is a counterpart of that accompanying this report, with the exception that there is no adipose tissue in their illustration.

Case 2. *Cystic degeneration of breast which had never secreted milk.*—Mrs. S—, æt. 34, the mother of one child seventeen years of age, consulted me in February, 1880, for some disease of her right breast. She had suckled with her left breast but not with her right as the gland never secreted milk, although it, in all other ways, appeared to be natural.

Three months before I saw her she accidentally discovered a lump in the right breast which had steadily increased. It was not the seat of pain but only of uneasiness. When I saw her there were four or five nodules the size of nuts in the gland, and these from their globular outline I took to be cysts. The whole gland felt coarse to the hand and knotty.

I punctured one of the nodules for diagnostic purposes and let out some serum. The others I left. Six months later, when last seen, there was no change in the breast.

The cysts were doubtless due to cystic degeneration of the gland from involution changes.

Case 3.—*Duct-cyst in breast with retracted nipple; albuminous fluid drawn off; cured.* (Reported by Mr. H. Caddy.)—Susannah B—, a healthy-looking, well-nourished woman, æt. 24, was admitted into Lydia Ward under Mr. Bryant's care on the 9th September, 1872, with a large hard substance in the centre of her left breast. The nipple had quite disappeared, from retraction, but the swelling seemed to point at the surface about an inch above where the nipple ought to be. There was no glandular enlargement in the axilla or above the clavicle.

The patient's family history had been good, and she herself had been healthy up to thirteen years old, when her back began to grow out both backwards and to the right side. She had no remembrance of any injury, and a year later she was employed in turning the mangle.

About four years ago her tonsils were cut, and two years later she felt slight pain in the upper part of her left breast, which became more severe when she raised her arm. One month before admission she noticed a lump about the size of a filbert, which was movable; a fortnight later there was a discharge from the nipple. She then sought advice from a medical man, who told her to bathe it with warm water; this benefited her at first, but the lump grew and the discharge from the nipple increased and became mixed with blood. She then came into the hospital.

On admission.—A very tense globular swelling the size of an orange was present in the centre of the breast. The nipple was flattened out and somewhat retracted; it discharged a yellow glairy fluid, which could be increased on pressing the tumour. The diagnosis of cystic disease of the breast was made.

September 12th.—A small cannula was introduced into the cyst and about four ounces of a pale yellow fluid were drawn off. A drainage-tube was introduced into the cyst.

16th.—The breast discharged a little for a few days, but it ceased on the 19th, and on the 21st she left the hospital well.

Two years later the patient reported herself as still well.

Case 4.—*Cyst in breast, which disappeared after tapping.*—Eliza T—, æt. 43, a married, childless woman, came to me February 12th, 1866, with coarse, indurated breasts, and a tense,

globular tumour the size of a walnut in the left gland which seemed to be a cyst; there was no discharge from the nipple. For diagnostic purposes this cyst was punctured and clear serous albuminous fluid drawn off. By April 16th the swelling had gone. Six months later no return had taken place.

Case 5.—*Duct-cyst in breast, which spontaneously suppurated, was opened and cured.*—Eliza H—, æt. 40, a married, childless woman, came under my care in April, 1870, with a tumour in her right breast which had been coming for five years, and was increasing slowly. She had had serous discharge from the nipple for two years. The axillary glands were not enlarged. At present there is a free discharge of a clear fluid from the nipple, which runs without, but can be increased with, pressure. At times the fluid is blood-stained. There is a tumour the size of an orange at the lower part of the gland. An incision was made into the cyst at its lower part and some ounces of pus evacuated. A good recovery followed.

It is probable that the spontaneous suppuration of a simple duct-cyst of the mamma is rare. I have not seen any other example, than the one recorded, in which it was clear that this took place.

In Prep. 4753 of the College of Surgeons there is, however, a cyst of this kind in which at one spot the inner surface of the cyst appears thinly covered with lymph, demonstrative of an inflammatory action. In this case, as in the one recorded in this paper, the nipple was retracted from traction on its ducts.

Case 6. *Cystic tumour of breast; cured by an incision into its cavity and drainage.* (Reported by Mr. Duckworth.)—Louisa N—, a healthy-looking married woman, æt. 45, was admitted into Lydia Ward, Guy's Hospital, on May 1st, 1879, under Mr. Bryant's care. Her paternal grandmother had cancer of the breast. About three months ago, she felt some pain in the region of the left breast, but noticed no lump for a month, when she felt one about the size of a walnut on the outer side of the gland. It was freely movable, and when she slept on her right side would slip towards the inner side. It was occasionally the seat of a gnawing or shooting pain. She has had one stillborn child, and never suckled.

On admission.—There is a hard, irregular, ovoid, lobulated swelling about the size of an egg, on the outer side of the left breast. It is very freely movable and the skin over it is not infiltrated. The tumour seems, however, to be slightly attached by one end towards the nipple, which is normal.

Operation.—May 6th, under chloroform, an exploratory incision was made about two inches in length on the outer side of the breast into the tumour, which was found to be a cyst. When opened about an ounce of clear fluid escaped. The cavity, which was smooth, was washed with iodine and water, after which a drainage-tube was put in and the wound dressed with terebene lint.

8th.—No discharge, wound healthy, drainage-tube removed. Temp. 97·8.°

12th.—Tinct. Ferri Perch. ♏x, Tinct. Calumb. ♏xx, aq. ℥j, t. d. s. Temp. normal.

20th.—The wound has nearly healed.

24th.—Discharged cured. Some months later this patient was well.

Case 7. *Cyst in breast treated by incision; doubtful thickening remaining; well.* (Reported by Mr. Duckworth.)—Harriet S—, a single woman, æt. 35, was admitted into Lydia Ward on May 21st, 1879, under Mr. Bryant's care. Six years ago she had an abscess in her neck. About four months ago, the patient experienced when at work a dragging pain in her chest and shoulder, and found upon examination a small hard lump, about twice the size of a pea, in her right breast. It was freely movable and occasionally gave pain at the back of her shoulder. She has no recollection of having received an injury.

On admission.—To the left of the nipple of the right breast there is a hard, irregular, lobulated lump the size of a small orange, with a base occupying about the area of a half-crown. It is freely movable and does not infiltrate the nipple or breast. The axillary glands are slightly enlarged.

May 21st.—She is menstruating; her menses have been irregular for some time. They generally last ten days.

27th.—Under chloroform, an incision was made over the tumour, radiating from the nipple and about two and a half

inches in length. Having cut into the tumour, about an ounce of brownish fluid escaped; the walls of the cyst were smooth. The parts were washed out with iodine and water and a drainage-tube introduced; the edges were then partially brought together with four sutures.

28th.—Temp. 98°, pulse 88.

29th.—Temp. 98·2° Two sutures taken out; wound looks healthy.

June 1st.—Temp. 98·9°, pulse 96. Wound closed well, narrow line of granulations on surface. A lump about size of a hazel nut felt below the incision.

24th.—Patient left the hospital cured.

Case 8. *Cyst in right breast; treated by a free incision; no intracystic disease; patient well two years later.* (Reported by Mr. Gowan.)—Mary S. R—, æt. 40, was admitted on October 15th, 1883, into Lydia Ward under Mr. Bryant's care. Patient is a tall, well-formed and well-nourished woman. She is a widow. Has never borne a child, and has never been injured in the breast.

Two months ago she first noticed a lump in her right breast about the size of a pigeon's egg, a little to the right of the nipple. It has grown somewhat rapidly since.

On admission.—The right breast does not appear much larger than the left. Both are well developed and firm. The right nipple is slightly tinged with brown, but not retracted, nor is the skin dimpled. A tumour, about the size of a large orange, occupies the upper and outer quadrant of the right breast; it is globular and smooth and indistinctly fluctuates. Neither the skin nor adjacent muscles are implicated apparently.

October 16th.—Under chloroform the tumour was punctured with a scalpel, when about one and a half ounces of blood-stained serum gushed out. The incision was enlarged and the cyst walls were found to be free from growth, smooth and thin. The wound was plugged with iodoform gauze, and dressed with gauze and flannel bandages; the arm was fastened to the side.

17th.—Passed a restless night; no vomiting. Dressings blood-stained, quite sweet, no clot.

18th.—No pain.

19th.—No appreciable discharge.

21st.—Patient feels unwell, but is menstruating profusely. Bowels not opened since operation. Had a slight rigor lasting fifteen to twenty minutes.

24th.—Bowels relieved and patient much better. Wound looks healthy and is free from pain.

26th.—Faint blush round wound, but temperature remained normal.

27th.—When she speaks she has shooting pain in breast. The blush has disappeared. Wound is quite sweet. Menstruation continues and bowels confined.

29th.—There is a lump just above the left nipple. It is tender, and makes patient anxious. Urine is slightly smoky. Wound dressed with terebene instead of carbolic oil, which had been used for a week. Still menstruating.

November 4th.—Ceased to menstruate, and is much better. Wound granulating up splendidly from the bottom. The left breast is no longer tender and is softer.

19th.—Left hospital; there is still an open granulating wound $1\frac{1}{8}$ inches long by $\frac{3}{4}$ inch. Patient's general health is good. Tumour in left breast *in statu quo.*

March, 1886.—This patient is quite well.

Temperature chart.

	Morning.	Evening.		Morning.	Evening.
Oct. 15.	—	98·4°	Oct. 26.	99·6°	99·4°
16.	—	99	27.	102·4°	102
17.	99·4°		28.	104	103
18.	99·8	98·4	29.	—	102·6
19.	99·4	99·6	30.	99·6	101·2
20.	98·6		31.	99·4	99·8
21.	99·2	98·8	Nov. 1.	99·2	
22.	—	103	2.	102·8	102·6
23.	101·4	102·6	3.	99·6	100·2
24.	100·8	101·2	4.	98·4	99
25.	99	100·2	5.	99	99

Case 9. *Deeply placed cyst in sternal lobe of right breast, simulating adenoma in gland; exploratory incision; plug.* (Reported by Mr. C. Lloyd Jones.)—Margaret V—, a domestic servant, æt. 37, was admitted into Lydia Ward on Feb. 23rd, 1877, under Mr. Bryant's care. She stated that her father died at seventy years of age of some internal tumour, her mother at

thirty of hepatic disease. Her brother and sisters were all healthy. She was unmarried and always enjoyed good health. She fancied that she had become a little thinner during the past winter, and lately her menstrual intervals had become three weeks instead of a month. Three weeks before admission she happened to place her hand on her right breast, when she noticed a lump there. She felt no pain in it and it had not increased in size since it was first noticed.

When admitted, the hand pressed flat against the breast at once detected, at the upper part of the right breast, a tumour which was nearly circular in shape, about two and a half inches in diameter, and flattened. It felt hard and its surface was distinctly lobulated. The tumour was movable with the breast, the skin was nowhere puckered nor adherent, and there was no pain on manipulation. The nipple was normal. No enlarged glands in axilla or elsewhere.

The patient could assign no cause for the appearance of the tumour, and she stated that she was, as she appeared to be, in very good health.

March 9th.—Under an anæsthetic, an incision was made into the tumour, when blood-stained serum escaped; the lining membrane of the cyst which occupied the posterior part of the lobe was smooth; the cyst was plugged.

15th.—Wound nearly well. The patient had not had one bad symptom or any rise of temperature.

Remarks.—In this case the true diagnosis was not at first made, nor was the true nature of the case suspected; the tumour had none of the appearances of a cystic growth, since it was quite inelastic, and its surface was nodular and hard.

The cause of this error in diagnosis is to be explained by the position of the cyst, which was covered in by gland of quite three quarters of an inch in thickness, the gland giving the nodular outline and yielding the firm feel.

At one time the question of infiltrating carcinoma was considered, on account of the growth so closely involving the gland and appearing as an infiltration, but this was dismissed in favour of the adenoid view, the outline of the tumour appearing more of the latter disease.

Had this case been punctured for diagnostic purposes its true nature would have been discovered.

Case 10. *Cyst of mamma mistaken for tumour and excised; cure.* (Reported by Mr. C. E. Perry.)—Anne F—, a married woman, without children, æt. 47, was admitted into Lydia Ward, under Mr. Bryant's care, on Jan. 18th, 1875, with a hard round swelling, about the size of a small tennis ball, in the upper and outer part of her left breast; it was movable with the breast and without pain except on pressure. It was regarded as a carcinoma. It appeared that an aunt on her mother's side had died of cancer in the breast. She herself had had good health until about five months before admission, when she felt a swelling about the size of a small egg in her left breast; it remained about the same, without pain, for three months, when, pain coming on, she sought advice and had some embrocation, which she left off after a few days, as it brought out a rash. She then fomented it and nothing else was done up to the date of her admission.

Jan. 26th.—Chloroform having been given the breast and tumour were removed by two elliptical incisions. On cutting into the tumour it was found to be a simple cyst full of fluid.

The patient did well after the operation and left the hospital convalescent.

The preparation is in the Guy's museum, No. 2290[80].

Case 11. *Sero-cystic disease of right breast; removal of lobe; inflammation of the remainder, and recovery.*—Mrs. S—, a childless, married woman, æt. 50, was brought to me by Dr. Wallace, of Hackney, March 15th, 1875, with a tumour in the axillary lobe of her right breast which had been steadily increasing for three months. The tumour was hard and lobulated, and I supposed the growth to be simple and advised its excision.

March 21st.—On excising the tumour I found it to be made up of cysts, and in making the section of the gland the whole breast was found to be full of small cysts (involution cysts), many of which I punctured. I could not remove the whole gland, as I had undertaken to remove the tumour alone.

During convalescence the remainder of the gland inflamed and indurated, putting on the clinical features of acute cancer. The induration, however, subsequently entirely subsided, and the patient recovered.

In 1881 she was quite well.

The tumour on removal was made up of cysts of various sizes, the largest being about the size of a walnut. The cysts contained fluid of different kinds. In some it was clear, in others blood-stained, whilst in a few it was mucoid and greenish. There were no intracystic growths. Some of the ducts were open and through these bristles could be passed.

The gland was clearly undergoing cystic degenerative changes and in the lobe removed these changes had gone on rapidly.

Case 12. *Sero-cystic disease of breast following injury; excision of gland; patient well two years later.*—Miss D—, æt. 34, patient of Dr. S. Tayleur Gwynne, of Whitchurch, Salop.

In June, 1864, she had a blow upon her left breast, which was followed by pain for two months and then the appearance of a swelling.

In January, 1865, when I saw her, the swelling clearly occupied the sternal half of the gland and was tense, giving the idea of a cyst. General health good. By December of the same year the tumour had increased and had become lobulated; it, moreover, was more painful. Nipple and lymphatic glands normal.

December 29th.—Breast removed and found to be a pure cystic disease of the gland. Cysts contained brown thin fluid, some clear serum. No intracystic growths.

Rapid recovery ensued and two years later the patient was well.

Case 13. *Sero-cystic disease of breast; excision of breast; patient well five years subsequently.*—Mrs. R—, æt. 40, the mother of seven children, was brought to me by Dr. Wilton, of Sutton. Her left breast has no nipple; it had been destroyed by old ulceration. The right breast is the seat of cystic disease, which involved the whole gland, and had been going on for months. The gland was very large, with an irregular outline, and clearly contained cysts of all sizes. The nipple and skin over the breast were normal.

January 29th, 1881.—Breast removed, and the operation was followed by a good recovery. The gland was full of cysts of all sizes which contained a great variety of fluids. No intracystic growths could be found.

January, 1882.—Pregnant. Natural delivery. Left breast strapped. No trouble.

1886.—Well.

Case 14. *Sero-cystic disease of breast; excision of breast; patient well eight years later.*—Mrs. S—, æt. 39, the mother of three children, all of which she had nursed without trouble, the youngest being fifteen years of age, was brought to me by Mr. Joseph Burton, of Blackheath, in 1876, with an irregular nodular tumour in her left breast, which had been coming on several months. It was apparently cystic and involved the whole gland. The skin over the gland was normal. Her mother had had cancer of her breast and the sister some internal tumour.

February 16th, 1876.—Breast removed. On section a large cyst without intracystic growth containing fluid as dark as ink was found, with many smaller cysts containing fluid of different characters. In fact, the whole breast was full of cysts of different sizes. A good recovery ensued, and in 1883, eight years later, the patient was well.

Case 15. *Cystic (duct) adenoma of breast; excision of lobe.*—Mrs. D—, æt. 45, the mother of four children, the youngest of whom was eight, and who had only nursed her first child, consulted me in April, 1876, for a tumour in her right breast which had been discovered six weeks and had steadily increased. I took it to be a cyst. The swelling was central and very cystic to the feel. The nipple projected more on the right than the left side and discharged blood-stained serum. The skin over the gland was healthy and the lymph-glands were natural. I advised puncture or incision and excision if the cyst was found to contain growth. The late Mr. Jardine Murray, of Brighton, did this in May, 1876, and found a pedunculated intracystic growth which on examination proved to be an adenoma. He then excised the affected lobe, and a good result followed.

Five years later this lady was well.

This case is similar to Cases 17, 18, and 31.

Case 16. *Case of cystic adeno-fibroma of the breast, in a woman, æt. 71; excision of gland; cure.*—Catherine K—, æt. 71, a healthy-looking woman, the mother of three children, was admitted into Guy's Hospital, under the care of Mr. Bryant,

on August 7th, 1865. She had always enjoyed good health, and had been able to suckle her children. About last Christmas, some time before admission, she accidentally discovered a lump the size of an egg in the outer side of her right breast; it was painless, and grew very slowly for three months, when it suddenly began to increase rapidly in size, and to cause pain. She applied to Mr. Bryant for relief, and remained under his care till she was admitted. On her admission the right breast presented a large tumour, the size of a cocoa-nut, closely connected with, if not in, the breast. It was irregular in its outline, and evidently in parts made up of cysts, for, in its projecting portions, distinct fluctuation was clearly felt. There was, however, much solid matter. The tumour was quite movable, and the skin over it was only stretched; the axillary glands were also healthy; the nipple was natural.

Nothing but excision promising to be of any use, the operation was performed on August 30th, and a rapid recovery took place; the old woman leaving the hospital in one month perfectly well.

On examining the tumour it was found to be made up of a firm solid material, which contained several large cysts. These cysts contained a blood-stained glairy fluid, and in parts the solid growth seemed to threaten to degenerate and break up.

The tumour measured seven inches by six; it was very firm in its consistence, and to the eye appeared of a sarcomatous nature; it was tough, and with difficulty broken down; in parts, however, it had more the aspect of the looser kind of adenoid tumours.

By the microscope the opinion formed by the naked-eye examination was confirmed, for the structure generally was an admirable specimen of the more fibrous kind of adenoid tumour; tubes were here and there visible, and, as a drawing by Dr. Moxon indicates, well-developed cell-structures (*vide* 'Path. Trans.,' vol. xvii, p. 283).

As an example of an adeno-fibroma in an old woman the preparation must be regarded with great interest.

Case 17. *Cystic (duct) adenoma of breast.*—Mrs. T—, æt. 54, the mother of several children, all of whom she had nursed without trouble, consulted me in October, 1880, for a tumour

of her breast which she had noticed for about a year. The appearance of the tumour had been preceded for months by the discharge of a serous fluid from the nipple. The tumour was about the size of a tennis ball, hard and globular; pressure upon it caused blood-stained serum to flow from the nipple. The skin over the swelling was natural, and the nipple was not changed. The diagnosis of a duct-cyst was made and an incision advised into the tumour with the view of an excision should an intracystic growth be found.

This was performed on October 23rd, 1880, and the breast removed, as a pedunculated intracystic growth was found (Plate II, fig. 3) in the cyst. A good recovery ensued, and the patient was well four years later.

The growth was examined by Mr. Symonds, who reports:

The growth was one and a quarter inches in diameter, and was attached by a small pedicle to the smooth wall of the cyst in which it was enveloped. It had a deep purple-red colour, was soft, and separated easily from its attachment. Round the cyst and in its wall were many dilated ducts, some of large size, but no direct communication could be traced. The cyst appeared to be produced by dilatation of a duct. Nowhere in the breast was there any other growth.

The tumour had a lobulated appearance, as exhibited in the drawing (Plate II, fig. 3), and microscopically showed all the characters of a pure adenoma (fig. 4). It is composed of large spaces of various shapes, lined by closely-set cells. These have large nuclei and one or more nucleoli. The supporting framework is a very delicate fibrous tissue containing cells of various shapes besides blood-vessels. From the walls of many acini grow conical projections which often blend with the opposite wall.

The tumour therefore appears to be a pure adenoma growing from the wall of a duct. The small amount of fibrous tissue, and the normal characters of the breast tissue immediately round the cyst, negative the view that it is a fibroma, budding into a dilated duct. This growth is identical with that called now a "duct papilloma."

Case 18. *Cystic-duct tumour with pedunculated adenocele of breast; excision; relieved.* (Reported by Mr. W. T. Crew.)

—Susannah W—, a single woman, æt. 43, was admitted under Mr. Bryant's care into Lydia Ward on February 2nd, 1876, with a globular tumour involving the whole of her right mamma and extending into the axilla, on the inner side of which there were little hard nodules like peas. The tumour within the breast-gland was freely movable under the skin and over the pectoral muscles; the veins were distended over the tumour. Fluctuation was very distinct over the greater part of the swelling; there was no discharge from the nipple, and the lymphatic glands were unaffected.

In 1872 she first noticed an exudation from her nipple like glycerine; soon after a lump the size of a walnut appeared in her breast without pain, and the swelling increased. The breast would sometimes feel tense, but become relieved as soon as the discharge took place. For six weeks there had been no discharge.

February 3rd.—The patient having a little cough the operation was deferred until the 8th, when chloroform having been administered an elliptical incision was made, and the whole tumour, with nipple and a portion of the skin, was dissected out and removed.

The tumour was mainly composed of a cyst which contained about half a pint of mucoid fluid, and was lined by a thin delicate white membrane; attached to its walls were several lobulated pedunculated tumours (Plate II, fig. 2). The growth examined showed a well-marked papillomatous structure. The processes are covered by long columnar cells, and often divide. Circular or elongated apertures lined by the same cells are also numerous. There are also small cysts with definite fibrous walls and colloid contents.

The growth closely resembles that in Mrs. T—'s case, No. 17, and suggests that the large cyst in this instance is also derived from a duct. The small cysts in this growth have been formed, I suppose, by the fusion of the processes in the manner described by Wilson Fox. Several smaller adeno-fibromatous tumours were also found on making sections of the gland in other parts of the breast. The arteries were twisted and sutures put in, pressure was exerted by pads of lint, and the whole wound drawn together by strips of strapping. She was not sick after the operation, and her temperature was normal.

11th.—The wound looked very well, and there was very little discharge.

21st.—The wound has healed by first intention.

Three years later the patient was well.

Case 19. *Cystic-duct adenoma; excision of tumour; cure.*—Harriet W—, æt. 47, the mother of thirteen children, youngest six years, all of whom she had suckled, was brought to me on January 14th, 1867, with a globular tumour, apparently cystic, in the upper part of her left breast, which she had observed six months. At first she had a clear discharge from the nipple, but she had not had any lately. The skin over the tumour is apparently bound to the growth. Axillary glands sound.

September 15th.—Serous discharge from nipple very free, increased by pressure. Tumour large.

March, 1868.—Tumour removed and found to be composed of a cyst with intracystic pedunculated growth which was pronounced by Dr. Moxon, after microscopical examination, to be adenoid.

Case 20. *Cystic-duct sarcoma of the breast which never secreted milk.*—Mrs. G—, æt. 45, the mother of one child, æt. 17, which she suckled with her right breast, but not with her left because she had no milk in it, and the nipple was likewise retracted, consulted me in February, 1881. For six years she had had a discharge of a clear fluid from the left retracted nipple, and more at the catamenial periods; the fluid at times was like "treacle water." Three months ago this flow stopped and a lump appeared.

A tumour the size of a walnut exists in the centre of the breast beneath the nipple. There is no discharge from the nipple. I advised incision and excision if necessary. Dr. Godfrey, of Balham, subsequently tapped the cyst and discovered a growth, the excision of which was advised, but not acceded to.

Case 21. *Cystic sarcoma of the breast fourteen years; removed; well seven years later.*—Mrs. B—, æt. 42, of Bottesford, Nottingham, the mother of four children, the youngest being four years old, all of which she had suckled, consulted

me in 1877 for a tumour in her left breast of fourteen years' duration. At the birth of the last child, four years ago, it was no larger than an egg. For the last six months it has grown rapidly and is now as large as a fist. It is clearly cystic from its nodular shape and fluctuating feel. There is no discharge from the nipple. No lymphatic glands enlarged. Excision was advised and performed, and a good recovery followed. In 1884, seven years after the operation, the patient was well. Her maternal grandmother had died from cancer of the tongue, and her paternal grandmother from cancer of the breast.

Case 22. *Cystic sarcoma of the breast; retracted nipple; excision; well eight years later.*—Mrs. S—, æt. 50, the mother of nine children, one alone of which she suckled without difficulty. Eight have died of phthisis at ages varying from fifteen to twenty-seven.

She has had a tumour in her breast for two years, and it has been steadily increasing. At present (March, 1876) it is the size of a fist, smooth, slightly lobulated, globular, and elastic; it appears to be cystic. The nipple does not discharge, but is retracted. Axillary glands free.

April, 1876.—It was excised by Dr. Sams, of Blackheath, who sent me the specimen.

April 11th, 1876.—Dr. Goodhart reported: "The tumour is spindle-cell sarcoma or recurrent fibroid, as I expected from its lobulated appearance and manner of growth. They are not at all uncommon in the breast and are often called adenoid growths from their very similar naked-eye appearance. It will probably return in cicatrix, though glands are less likely to be involved in axilla."

In 1884 this lady was still well.

Case 23. *Cystic sarcoma of breast; rupture of cyst; hæmorrhage; excision; recovery.*—Mrs. S—, æt. 71, consulted me in January, 1873, for a tumour of the breast of twelve years' growth. It was then the size of a child's head. One cyst had ruptured, and an intracystic growth sprouted from its centre which bled freely. On this account an operation was advised, and performed on Feb. 26th, 1873. A good recovery ensued. The disease was on examination found to be one of cystic dis-

ease with intracystic sarcomatous spindle-celled growths. This lady died, more than three years after the operation, in September, 1876, from acute bronchitis.

Case 24. *Cystic sarcoma of the breast; rupture of cyst; operation refused.*—Clara W—, æt. 43, the mother of three children, the youngest being fourteen years old, consulted me on March 7th, 1867, for a tumour the size of an orange in her left breast, which had been growing thirteen months. It was globular, semi-elastic, and nodular. The skin, nipple, and axillary glands were sound.

April 7th.—Tumour much larger, its bossy surface is lost, and the growth seems to be one large cyst. Cyst tapped and about one ounce of blood-stained fluid drawn off.

June 2nd.—Tumour size of cocoa-nut.

July 8th.—Tumour burst and discharged fluid full of blood. Operation refused. Intracystic growths visible, later on some projected through the rupture in the cyst wall.

July 16th, 1868.—Patient sinking from asthenia and bleeding from the growth.

Case 25. *Cystic sarcoma of breast; rupture of cyst; operation rejected.*—Mrs. R—, æt. 63, married at age of twenty-one and had five children, the youngest aged thirty. Nipple in left breast always retracted. Thirty years ago, independently of nursing, she had a tumour the size of a fist in her left breast, which disappeared after one year. She remained well for twenty-eight years, up to one year ago, when the swelling reappeared in the same breast and this has gradually grown.

At present (July 9th, 1873) a tumour the size of an egg exists in the upper part of the breast which seems to be a cyst; this is adherent to the skin. Excision of the tumour was advised but not accepted.

January 19th, 1874.—The cyst, which has much increased in size, has ruptured and discharged its contents, a sarcomatous growth protruding from the skin opening. No operation was sanctioned.

Case 26. *Cystic sarcoma of breast; suppuration of a cyst followed by rupture of cyst; no operation.*—Mrs. C—, æt. 43, of

Hull, the mother of five children, her youngest child now fourteen years of age. After giving up nursing had discharge from her nipple of a clear greenish or blood-stained fluid. Six months ago this discharge ceased, and the breast enlarged, inflamed, and suppurated. It was opened at that time by Mr. W. H. Rudd (April, 1883) and the abscess healed, leaving a lump. This increased in spite of treatment, and is now the size of a large egg. It appears to be (February, 1884) cystic. Incision into the cyst was advised, and excision of the lobe advised if growth was found. Nothing was, however, done, but the cyst burst and discharged bloody fluid, and this has been going on up to the present (October 12th, 1884).

Case 27. *Cystic sarcoma.*—Mrs. S—, æt. 70, has had three children, which she never suckled. In 1875 she consulted me for a tumour in her right breast which she had had four years; when seen by me it was the size of a cocoa-nut, clearly cystic, and nodular. No lymphatic glands were enlarged. Skin normal. Operation not advised on account of age.

Case 28. *Cystic fibroma of right breast with cystic degeneration of the gland; excision of tumour; cured.* (Reported by Mr. Metzgar.)—Rebecca B—, æt. 40, was admitted into Lydia Ward on June 21st, 1884, under Mr. Bryant's care.

Patient's father and two brothers died of phthisis, and she frequently suffers from bronchitis and neuralgia. She is married and has one son alive and healthy.

Six weeks ago she noticed an uncomfortable swelling in her right breast, which appeared as a prominent tumour in the upper half of the gland. This tumour has not increased much since then, but it has seemingly got softer.

On admission.—The tumour is hard and nodulated, firmly embedded in the gland but freely movable with it upon the pectoral muscles. The skin over it is normal. The axillary glands are not enlarged. Nipple natural. Urine normal.

June 24th.—Under chloroform an oblique exploratory incision was made into the tumour. The tumour when incised appeared granular and fibrous, a fibroma apparently growing from or into a cyst; the breast itself had undergone cystic degeneration. The tumour was then freely separated from the

surrounding breast tissue and removed. In so doing black cysts were seen spread over it. The vessels having been twisted and capillary hæmorrhage stopped by hot iodine sponges, three silk sutures were put in and one and a half inches of drainage-tube into the upper and left end of the incision, the lower or right half being well padded with lint and a sponge. The arm was strapped to the side.

June 25th.—Drainage-tube removed.

30th.—Stitches removed as well as drainage-tube. Lips of wound drawn together with waterproof strapping.

July 11th.—There has been good primary union. There is very little discharge. A plug of terebene lint put into the lower and right end of wound.

26th.—Went out, to come up from time to time to be seen. This patient was subsequently quite well.

The tumour when removed proved to be a fibroma growing from the walls of a cyst. The gland itself was full of small cysts the result of degeneration.

Temperature chart.

	Morning.	Evening.		Morning.	Evening.
June 23	98·6°	99·2°	July 4	98·6°	99·4°
24	98·4	98·8	5	98·6	97·2
25	100·6	101·4	6	98·4	98·8
26	98·2	99	7	98·6	98·4
27	99·6	101	8	98·8	98·4
28	98·6	100·4	9	98	98·6
29	100·6		10	97·8	98
30	98	98	11	99	98·2
July 1	98	99·8	12	98·6	97·8
2	98·4	98·8	13	98	
3	98·2	98·4		Normal.	

Case 29. *Recurrent mammary cystic sarcoma; excision; well.* (Reported by Mr. H. H. Wright.)—Eliza M—, æt. 36, was admitted into Lydia Ward on July 14th, 1880, under Mr. Bryant's care. Patient is a married woman and the mother of eight children. Three years ago she was operated upon for tumour of the left breast; the tumour was removed but the breast was left. She has since been able to suckle a child at the same breast. A year ago she noticed a small lump above the nipple which has steadily increased. On admission there

was a large lobulated tumour involving the whole of the left breast. Divided into two chief parts, one of these occupies the central and upper part of the gland; the other, which is smaller, is placed on the axillary side. The whole tumour is above the level of the old cicatrix. It is freely movable, partly hard and partly elastic to the touch. One point above and to the inner side of the nipple is inflamed and painful.

July 20th.—Under an anæsthetic the whole mass was turned out with the breast-gland.

The patient suffered a little from conjunctivitis after the operation, but otherwise did well, and on August 16th went out, the breast having healed.

Description of tumour.—The tumour was everywhere encapsuled. It was composed of many lobules separated from one another by fibrous septa and each enclosed in a capsule. Some of them grew into thin-walled cysts containing little or no fluid, their walls being in contact. The growths in these cysts were in some cases lobulated finely on the surface. In a few, they resembled in colour and smoothness a mucous nasal polypus, but were in consistence a little firmer. The majority of the lobules showed on section a finely lobulated appearance, the outlines of the little lobules being crenulated, and some having a distinct cavity in the centre. No communication could be traced between the various cysts nor could any be traced directly to the nipple. Some parts of the growth were hard, firm, and fibrous. There were no blood-cysts nor any of the translucent-looking material so common in a sarcoma. In some of the nodules (felt elastic during life) there were many elongated slit-like spaces with smooth walls, the surrounding material being acinous.

Histologically the tumour was composed of spindle cells and gland elements (adeno-sarcoma).

Case 30. *Cystic (duct) sarcoma of right breast; early symptom, hæmorrhage from nipple; amputation.* (Reported by Mr. Phillips.)—Eliza A—, æt. 45, a governess, was admitted into Lydia Ward on Jan. 8th, 1884, under Mr. Bryant's care. Patient was delicate, but never had any particular disease. Breasts have been always tender, but no history of injury. Menstrual periods regular.

In January, 1883, one year before admission, patient first noticed a pale brownish discharge from the right nipple. It lasted three months and was increased during her menstrual periods. In March she noticed a lump the size of a small marble on the upper and inner part of her right breast. This increased visibly during her menstrual periods. About two months ago it began to grow and since then her menses have been irregular.

On admission.—Patient is a florid-looking woman and apparently healthy. The upper and inner aspect of the right breast is occupied by a "firm but not hard" lump measuring $2\frac{1}{4} \times 1\frac{1}{2}$ inches, and with the longest axis vertical. The lump is painful. There is no fluctuation. The skin is not very movable upon the growth. A hard cord can be felt running down from the growth to the nipple. During pressure upon the tumour a few drops of serous fluid mixed with blood came from the nipple. Under the microscope this fluid was found to consist of blood-corpuscles forming rouleaux. A small gland the size of a nut exists in the axilla.

The breast was removed and found after removal to have been the subject of cystic degeneration of the gland. Into some of the cysts sarcomatous growth of the spindle-celled variety existed (*vide* drawing, Plate II, fig. 1).

19th.—There was primary union all down the wound except at its lower part. The uppermost stitches were taken out.

26th.—Drainage-tube taken out.

February 1st.—There is perfect union of wound.

9th.—Discharged well.

Temperature chart.

	Morning.	Evening.		Morning.	Evening.
Jan. 15	—	99·6°	Jan. 27	99°	98·4°
16	99·2°	101·2	28	98·6	99
17	101	101	29	98·8	98·6
18	99·8	100·6	30	98·6	99·6
19	99·6	100	31	99	
20	100·2	99·6	Feb. 1	103	99·6
21	99·4	100	2	98·6	99·2
22	101	99	3		
23	98·8	98·8	4	98·6	99·2
24	99	98·6	5	98·6	98·8
25	98·4	98·8	6	98·6	98
26	98·6	100			

Case 31. *Cystic adeno-sarcoma of breast; excision.*—Miss C—, æt. 46, consulted me on July 10th, 1885, for an affection of her left breast which had been coming on for about six months and accompanied with some pain. The whole gland seemed to be indurated and enlarged, and to the hand felt coarse and nodulated; below the nipple a hard mass was felt. The nipple was natural and discharged a blood-stained fluid, more particularly after manipulation. The skin over the breast was natural, and the lymphatic glands were not enlarged.

On July 11th the breast was excised and a good recovery ensued.

To the eye the breast was clearly undergoing cystic degeneration, the whole gland being full of small cysts. In one lobe these cysts had much increased and one of them contained an intracystic growth. The cysts had evidently a connection with the ducts, since during life there was a nipple discharge, and after the removal of the gland fluid could be squeezed out of the nipple.

Mr. Symonds' report on the case is appended.

Report of case by Mr. Symonds.—The breast was found to contain a large cyst in the tissue just beneath the nipple, measuring one inch across. Projecting into one end of the cyst was a rounded solid growth, with an uneven papillomatous-looking surface. This extends beyond the limits of the fluid-containing portion of the cyst as a solid cylinder, round which the cyst wall is closely fitted, so that in a transverse section the appearance is much that of a large vein filled with a growth. The section has a whitish-grey colour. No other cyst of any magnitude was seen, but there were many small ones. The rest of the breast looked fairly healthy. The tissue was hard, but no definite tumour was visible.

Microscopic examination.—The solid growth is composed of irregular glandular acini, lined by short columnar cells, with a deeper layer of a less regular form (woodcut, Fig. 1). In many places the cells are heaped up and then are smaller. The stroma is composed of fine fibre tissue, and contains here and there a cavernous arrangement of vascular tissue. It is very delicate in parts and forms but a small portion of the whole; in other places, however, especially where the growth is con-

nected with the wall and outlying breast tissue, there is much solid material. This contains much fibre tissue, spindle cells, and a few myeloid, and closely resembles a sarcoma. This solid growth does not form a separate tumour in the breast, for at no great distance from the cyst wall the ordinary mammary tissue is reached. Such a structure as that described might be looked upon as the starting-point of the growth, but it forms so small a part of the whole and reaches so short a distance into the breast tissue proper, that the view seems not so reasonable as the one stated below. The cyst wall is lined with the same short columnar cells, and the relation of the two is seen in the woodcut.

Fig. 1.



There are other cysts visible under the microscope varying from a size slightly larger than a normal acinus to $\frac{1}{8}$th inch across. The smallest, as seen in Plate I, fig. 3 are evidently dilated acini and ducts. These are lined with rounded or columnar cells according to their source of origin. The larger ones, of which two or three were found, contain, besides the granules, large round or oval cells with nuclei, and these cysts are lined by peculiar large cells shown in Plate I, fig. 2.

They exhibit an intracellular and intranuclear network, have a more or less columnar shape altered by pressure, and large prominent nuclei. They are set directly upon a wall of close fibre tissue containing elongated nuclei. In places these cells are heaped up and proliferating. They are undoubtedly the progenitors of the large granular cells found in the cysts. Sometimes cells of this character are found filling spaces in the glandular formations, and showing in great contrast to the dark, short columnar cells, for they are themselves pale, except for the nucleus and granular appearance. In these smaller cysts there are also found glandular growths, connected with the wall. Where attached to the wall there is no solid growth in the neighbouring breast tissue.

So far as the description has been carried it will appear that there is no solid growth except that found in the cysts.

Examining other parts of the breast it is found that everywhere some change is going on,—that there is a widespread activity manifesting itself throughout the entire organ, culminating in the formation of cysts and glandular growths. Again, it must be stated that nowhere is any highly nucleated tissue to be found, except on the margin of the large cyst above referred to. The fibre tissue is dense and contains few nuclei, and everywhere fat is found, so that in all the illustrations adipose tissue, where not sketched, will be considered to be present close to the acini.

The presence of the fat seems a good evidence of the fact that we are dealing with a diffused change in the breast, and not with a widely disseminated tumour, a point insisted upon by Cornil and Ranvier.

The first departure from the normal structure is seen in the acini. The cells are increased in number and obscure the lumen, and the wall shows as a thickened fibrous investment, with very few nuclei.

Next several acini fuse together by obliteration of the intervening septa as in Plate I, fig. 4. Fig. 4 is a good example, and illustrates a process seen in all parts of the breast in varying degrees. The cells are smaller and more irregular than the normal ones. In some places, but this is exceptional, fibre tissue is produced at the same time, and we have the appearances presented in Pl. I, fig. 3, of an alveolated stroma of

fibre tissue, the spaces of which are filled with epithelial cells. In the centre of some spaces is seen a lumen, while in others the cells have accumulated to such an extent as to obliterate all trace of it. In the drawing only some of the cell groups have been filled in.

Such are the various morbid appearances seen in this breast. The sequence of events it is not so easy to arrange, for though there are some small adenomatous growths in cysts, I cannot follow the development of such out of the earlier changes detailed above.

It remains to me a doubtful point whether the intracystic adenomatous growths arise by proliferation of the epithelium lining a dilated acinus or duct, or whether they arise out of such a process as is seen going on in fig. 3. The large epithelial cells lining some of the cysts, and shown in fig. 2, are probably altered duct epithelium.

It is important to compare this with the sketches of the breast from Mrs. T— (Case 1), where a pure cystic change is seen, Pl. I, fig. 1, and with that of Mrs. T— (Case 17), where a pure adenomatous growth hangs by a pedicle to the wall of a cyst, Pl. II, figs. 3 and 4. Whatever view be taken of the sequence of events in this breast the following conclusions seem justified:

1. That the change is a general one.
2. That there is no new solid formation outside of cysts.
3. That the departure from the normal begins in the epithelium of the ducts and acini, and proceeds either towards cyst formation or fusion of many acini, to one or to both of which changes new formation of gland tissue succeeds.

It may, I think, also be surmised, when we consider the appearances presented by the large cyst in Case 1, and the connection between the intracystic growth and the cyst wall in this case and shown in woodcut, Fig. 1, p. 471, that the glandular formation arises by outgrowths from the cyst wall, and is a pure intracystic growth, and not a protrusion inwards of a tissue formed outside the acini and ducts. As in Cases 15 and 17 the growth may be viewed as an adeno-sarcomatous papilloma.

Case 32. *Cystic sarcoma of right breast; ulceration of skin over it; excision; recovery.* (Reported by Mr. H. Dismorr.)

—Dora G—, an anæmic-looking woman, æt. 53, was admitted into Lydia Ward on December 16th, 1873, under the care of Mr. Bryant. She had noticed for many years in her right breast a lump, at first not larger than a nut. Her sister while in bed had put her elbow on the patient's breast whilst raising herself up. This gave her a great deal of pain, and the small lump then appeared; it gradually increased in size, but did not trouble her much till about six weeks before admission, when she caught cold and it enlarged rapidly; the skin broke in two places over two prominent lumps, the bridge between them gave way and united the separated sores; these increased in size and discharged very much. On admission, the breast was the seat of a tumour the size of a cocoa-nut, which was somewhat nodulated on the surface; the skin on the inner side of the nipple was red from capillary congestion; on the outside there was an ulcerated surface five inches by four, which was in great part covered by a blackish slough. The edge of the skin, though adherent to the tumour, was not infiltrated by new growth. The glands in the axilla were enlarged, but there was no enlargement of the abdominal viscera, and the other breast was healthy.

On December 23rd she was put under the influence of chloroform and the tumour was removed by two semi-elliptical incisions, with the enlarged axillary glands. The two edges of the wound were brought together and supported by strapping. There were no adhesions of the tumour to the deeper parts. A section of the tumour showed a large single cyst with definite walls, its cavity being filled with sessile growths of a lobulated form, tough consistence, and gelatinous look. The microscope showed it to consist of a loosely fibrillated connective-tissue spindle-celled sarcoma and a larger number of round fatty nuclei scattered through it.

After the operation a morphia injection was given, which greatly relieved the patient, but she was very sick the day after, and perspired freely for some two or three days.

29th.—The wound is looking very healthy and covered with granulations. There has been a little diarrhœa, accompanied by pain in abdomen. Temp. 98·6°, pulse 78.

January 17th, 1874.—The patient has gone on improving; there has been a good deal of perspiration, at night particularly,

after which she complained of weakness, but her appetite has been good. Six pieces of skin were transplanted to the wound, four of which seemed to take. She used to get up for an hour or two in the day. The wound decreased in size, and on the 27th was the shape of a triangle, each side being about two and a half inches long.

29th.—Eight pieces of skin were transplanted, six of which were thought to have taken five days later from this time. She went on capitally and left the hospital on February 9th, the wound still being the same shape, but having lessened in size half an inch in ten days.

This patient was known to have been well three years later.

Case 33. *Cystic carcinoma (?) of breast; excision.*—Miss S—, about forty-five years of age, consulted me on December 19th, 1884, on the advice of Mr. Bisshopp, of Tunbridge Wells, for a tumour involving her right breast of more than two years' growth. She was first seen by Mr. Bisshopp in November, 1882, when the tumour had been discovered some months. It was then hard but painless; it grew gradually. When I saw her, the whole breast seemed to be involved in the disease and was hard and nodular. The nipple and skin over the breast were natural. I regarded the case as one of cancer and advised its speedy removal. Sir James Paget saw the case and gave a like opinion. On January 9th, 1885, the operation was performed, and the wound healed at once by quick union.

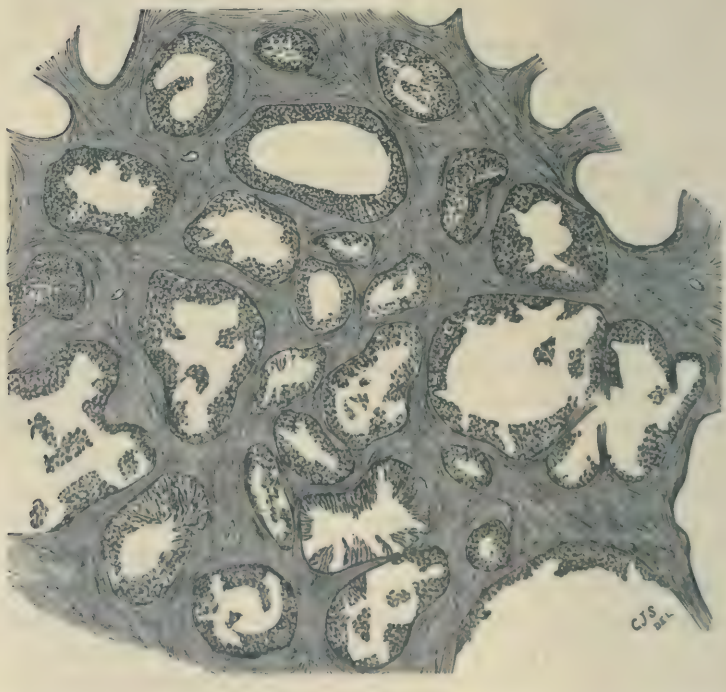
The lady is now (eighteen months after the operation) well.

Report of tumour by Mr. Symonds.—The tumour was situated beneath the nipple in the substance of the breast and measured about 1½ by 2 inches. The section when fresh showed a pinkish colour with many yellow spots resembling altered secretion, plugging ducts. There were, besides, many larger spaces with smooth walls, filled with a yellowish-grey or darker thick fluid. The tumour was not limited by any capsule, but blended directly with the breast, and in some places with the adipose tissue. When a thin slice was cut and the yellow contents of the spaces removed, the whole closely resembled cavernous tissue, so numerous were the spaces and so scanty the stroma. Examined microscopically in water, the yellow material was found to be composed of cells of all shapes and in

all stages of degeneration, the prevailing shape being an irregular columnar. Numerous fatty granules, and plates and rounded or irregular masses of carbonate of lime also were present.

The microscopical appearances are shown in the large drawing made under a low magnifying power (Fig. 2). The spaces are of various sizes and shapes, are all of a tubular

Fig. 2.



character, and most of them have a distinct lumen, occupied when fresh by the yellow material above described, and which has nearly all fallen out in the preparation of the section. The epithelium lining these spaces, the characters of which, under a high power, are shown in Plate I, fig. 5, is arranged mostly in a double or triple layer, having a distinct dark line where uniting they limit the lumen, an appearance resembling the striated border of Brücke. In other spaces the epithelium is

more abundant, and forms irregular elevations projecting towards the lumen, which is in some instances entirely obliterated. Under a high power this last arrangement closely resembles an alveolus of an ordinary carcinoma of the breast. The stroma is fibrous, with very few nuclei or vessels, differing in these respects markedly from the stroma of new growths generally. The epithelial cells (Plate I, fig. 5) are large, angular, closely fit into one another, and have prominent round or oval nuclei. As they increase in number many become granular and some vacuolated.

The growth was not confined to the nipple, but was placed somewhat below this point. Moreover, it invaded the surrounding adipose tissue. On these grounds, and on account of the large size of the tumour, the large number of the spaces, and the absence of any large cysts, the formation must, I think, be considered as no mere duct dilatation, but a new growth, the prevailing character of which is its tubular form. This character is determined probably by the seat of origin, for when contrasted with another case, that of Mrs. T— (Case 1), the absence in all the sections of ordinary breast tissue and fat, confirms the view that this is a new formation.

Case 34. *Cystic cancer of breast.*—Miss B—, æt. 43, for ten years has had clear discharge from her left nipple, gluing it to her linen. At times the discharge has been blood stained; she has had occasional sharp pain in the breast. The catamenia regular.

Seven years ago the lump was the size of a nut, now (April, 1882) it is the size of an orange.

The lymphatic glands and the skin over the breast are healthy. Breast excised by Mr. Shipman, of Grantham, and found to be cancerous.

The growth had clearly grown from a cyst.

Case 35. *Cancer of breast following cystic disease coming on after prolonged suckling.*—Sarah C—, æt. 44, the mother of one child, which she suckled for three years up to six weeks ago, applied to me on April 25th, 1865, for a soft swelling the size of an egg in the outer lobe of her right breast. It was fluctuating and had been coming two months.

Under tonics the swelling seemed to get smaller, but in June the skin over it became adherent and in July pus escaped from the nipple.

On August 17th the cyst burst and discharged a yellow serous fluid. The case then did well.

In January, 1866, patient reappeared with the breast generally infiltrated and fixed to the chest; the skin over the breast was likewise infiltrated and in one spot ulcerated.

At this time the diagnosis of an acute carcinomatous infiltration of the breast was easily made, and from the history of the case it seems probable that it originated within the cyst of which the report gives a history.

Had the cyst been excised when first treated, the cancerous disease might have been prevented.

Case 36. *Cystic carcinoma of breast following blood-cyst; excision of breast; return and death in one year.*—Mrs. C—, æt. 58, nursed eight children without trouble. Lump in right breast for six months, having been preceded by a discharge from the nipple of blood for one and a half years. When I first saw her on May 5th, 1876, there was a cyst the size of a walnut on the outer side of her right nipple. By pressure all the sanguineous fluid could be squeezed out of it, and the wall of the tumour fell in, leaving a concavity. Pressure was applied to the tumour by cotton wool and strapping.

November 29th.—No tumour can be felt. The hollow beneath nipple is still distinct. No discharge from nipple for three weeks.

July 28th, 1879.—After the lapse of three years nipple retracting; some thickening in seat of cyst. No discharge from the nipple, skin slightly infiltrated over seat of old cyst. No axillary glands enlarged.

August 6th.—Excised breast; good recovery.

June, 1880.—Died with internal cancer.

The interest of this case rests on the fact that for at least four years before any symptom of local cancer appeared there was clear evidence of the presence of a duct-cyst. That the cancer developed in the cyst there can be little question, since it was in the seat of the cyst and of the gland over it that the first signs of carcinoma appeared.

It was a source of regret to me when I saw this serious trouble, that excision of the breast had not been performed earlier. The results might then have been different.

Case 37. *Carcinoma involving mamma the seat of cystic disease; excision; return five years later.*—Mrs. S—, æt. 42, the mother of one child, consulted me in February, 1876, for a tumour in her left breast which she had discovered four months, and which has steadily increased.

Tumour was situated in the axillary lobe of the gland; nipple natural. Axillary glands free. The growth was clearly scirrhus.

Excision.—Axillary lobe infiltrated with carcinomatous material and simple cysts in other parts of the gland, one filled with inky fluid; no intracystic growths.

Good convalescence.

Remained well for nearly five years, that is till December, 1881, when signs of return of cancer appeared in the cicatrix.

Case 38. *Cystic carcinoma of breast following upon ordinary scirrhus.*—Ann C—, æt. 60, came under my care in July, 1864, with an infiltration of her right breast. Three months later the skin over the gland became adherent and infiltrated and the axillary glands enlarged.

In April, 1865, a cyst appeared in the upper part of the tumour and rapidly increased, so much so that in July it threatened to burst. This, however, did not take place. In September chest complications appeared which destroyed life.

Case 39. *Cystic carcinoma of breast; excision; cure.*—Ann C—, æt. 49, the mother of five children, all of whom she suckled.

For four and a half years had discharge of blood-stained fluid from the nipple, which could be increased by pressure.

The gland has been steadily enlarging during this period.

April 17th, 1865.—Breast large and nodular. Skin adherent to the breast and nipple retracted; tumour clearly cystic in its nature. The breast was subsequently excised and the patient recovered. The disease was, as suspected, cystic carcinoma, the gland being full of cysts and the cysts of intracystic carcinomatous growths.

Case 40. *Cystic carcinoma of breast; sloughing of growth; hæmorrhage; removal; relieved.* (Reported by Mr. L. Burroughs.)—Harriet A—, æt. 70, was admitted into Lydia Ward on January 28th, 1879, under Mr. Bryant. She has had four children, the youngest of which is now thirty-five years of age. There is no history of tumours, and patient has always been healthy.

The patient first noticed a small lump in the axillary portion of her left breast ten years ago, and it has continued to increase in size since. On Friday evening last it began to weep with blood.

On admission.—The left breast is occupied by a hard infiltrating growth which implicates the skin and deeper parts, extending from near the left border of the sternum to the middle of the axilla, and from the third rib above to a point in a line with the ensiform cartilage. The breast is not distinguishable, and the site of the nipple is occupied by a depressed ulcerating induration marked with dilated vessels; the ulceration is superficial and covers an area an inch in diameter. External to this is a large, oval, fluctuating swelling, limited above by a deep furrow. The swelling is about three inches by two; the skin over it is thin, red, and livid; about the middle of it is a black spot, from which the hæmorrhage took place on the 24th inst. There is no enlargement of the axillary gland.

On the 28th and 29th more hæmorrhage.

January 30th.—The cyst has collapsed; the skin around the opening is sloughing, and it is discharging a fœtid grumous-looking material.

January 31st.—*Operation.*—Two elliptical incisions were made from the median line of the body running obliquely downwards and outwards, about five inches in length and three inches apart at the centre. The whole of the breast and carcinoma were removed as far down as the pectoralis major. The wound was washed with warm iodine water, two silver sutures were introduced at the upper angle of the wound, and a piece of terebene lint applied over it with a bandage to keep the dressings in their place.

February 2nd.—The wound was dressed and the silver sutures removed.

3rd.—Temp. 99·2°, pulse 80, and irregular.

4th.—Temp. 98·6°, pulse 108, more regular. Tinct. Ferri Perch. ♏x, Sp. Chlor. ♏x, Quin. Sulph. gr. j ter die.

6th.—Temp. normal. The wound looks more healthy.

10th.—Granulations look fairly healthy. There is not much discharge.

11th.—Patient feels comfortable.

March 10th.—The temp. has remained normal. The pulse became more regular, and the wound has been gradually filling up and healing, and the patient was discharged to-day convalescent.

The walls of the cyst after excision on section showed small round cells. The hard mass was evidently scirrhus undergoing fatty degeneration. It was in one large cyst which had ruptured. There were other cysts filled with cancerous growths.

Case 41. *Cystic carcinoma of mammæ, with cystic degeneration of breast; excision; relieved.* (Reported by Mr. Udale.)—Mary Ann W—, æt. 50, was admitted into Astley Cooper Ward on June 15th, 1878, with a hard swelling reaching from the nipple upwards two inches. The nipple was retracted and the skin was adherent to the growth beneath. The axillary lymphatic glands were not enlarged. Her previous history was good, as was that of her family.

It was only about six months before her admission that she first noticed a little pain in the breast, and a dimpling of the skin, beneath which was a small lump. The lump increased in size and became very painful when touched. She was advised to seek advice at the hospital, and saw Mr. Bryant, who advised the removal of the breast.

June 16th.—Chloroform was administered, and the breast removed. The mass was found to be cancerous, and cysts were found to be freely distributed throughout the gland tissue.

17th.—Temp. 102°, pulse 99. She complained of a bad headache, but the following morning became much better.

20th.—The wound was redressed, absorbent paper lint being used. The lower two thirds of the wound had united by primary union, the upper third was healing by granulations. She was ordered Haust. Sennæ as her bowels had not been opened.

22nd.—The wound was healthy; there was not much discharge.

29th.—The wound had been healing well, but it had now in its lower third broken down again. There was also a little discharge from the upper part.

August 5th.—Her bowels had been very irregular since the operation and aperient medicine which had been given to her had upset her. Nearly the whole of the inner part of the wound had healed up.

From this date her progress was uninterrupted, and she left the hospital on September 17th convalescent.

Case 42. *Recurrent carcinoma of mamma; excision; relieved; carcinoma of cyst.* (Reported by Mr. F. Hitch.)—Jane R—, æt. 47, a married woman and the mother of eight children, six of whom were living, the youngest being fifteen years of age, was admitted into Lydia Ward on 15th October, 1877. She had suckled all her children with her affected breast.

She had always enjoyed good health until about twenty months before admission, when she noticed for the first time a little lump in her right breast about the size of a walnut. Ten months later it increased rapidly.

On February 9th she was operated upon at another hospital, and the tumour was removed, leaving the breast and nipple, which were not infiltrated. She left the hospital on March 11th, with the wound perfectly healed.

On admission.—The patient stated that about two months after her discharge from the hospital she noticed a slight swelling in the cicatrix of the old wound as well as pricking pains; the growth rapidly increased in size until it became a circular tumour four inches in diameter, a little to the right of the sternum. It was hard to the touch, movable over the pectoral muscles and infiltrated the skin for three inches. The skin was purple and shining and had about its centre a small prominence.

October 23rd.—Chloroform was administered and the tumour was removed by two incisions enclosing a space about five by six inches; there was but little hæmorrhage. The growth had to be dissected off the pectoral muscles. The incision left a large cavity into which a metal porringer without the handle

might be embedded. This was left to granulate. One suture was, however, put in at the right hand side of the wound.

The tumour when cut into exhibited a large cavity containing serous-looking fluid. The walls were composed of very soft cancerous growth made up of epithelial elements.

The patient was a very nervous subject, and was very sick after the operation.

25th.—The sickness had continued ever since; she felt very weak.

26th.—The breast was dressed with absorbent cotton and terebene and the suture was removed. There had been no hæmorrhage and she felt very comfortable. The wound looked healthy.

29th.—The pus discharged was very thin.

30th.—She was ordered Mist. Quin. ʒj, t. d. s. Temp. 102·9°.

November 1st.—There was an inclination on the part of pus to burrow towards the axilla. The granulations appeared to be healthy.

5th.—The wound was getting smaller.

9th.—She sat up a little and felt better.

16th.—There was a small growth, the size of a cherry, noticed to be growing from the bottom of the fossa near the lower and right side. This was thought to be a portion of the old growth left behind after the operation. The following day it was removed. There was very little bleeding and not much pain.

21st.—There had been no increase of temperature. The patient was doing remarkably well.

December 7th.—The wound looked healthy.

12th.—She left the hospital.

Six months later this patient was well.

In this case the evils of a partial operation for carcinoma are well illustrated, for had the rule which is generally considered by surgeons as a binding one been observed, and the whole breast been removed when the primary tumour was taken away, the second operation would not probably have been called for.

Case 43. *Cystic sarcoma of one breast; removal; followed in nine years by cancer in opposite breast.*—Mrs. W—, æt. 60,

the mother of one child, which she could not nurse as her nipples were retracted.

Twenty years ago she had a small lump in her right breast which disappeared entirely in the course of two years.

February, 1872.—Observed lump in same spot, which has increased rapidly, so that now (April, 1873) it is the size of a cocoa-nut. Tumour clearly lobulated and cystic; axillary glands free.

The breast was removed and was clearly cystic spindle-celled sarcoma; a good recovery followed the operation.

June 14th, 1882.—A tumour appeared in left or opposite breast which infiltrated gland and gave rise to retraction of nipple and puckering of skin, an example of ordinary carcinoma.

Nothing was done as the patient refused to be operated upon.

This case is worthy of record as an example of a patient having a carcinomatous tumour of one breast follow upon the removal of a cystic sarcomatous tumour in the other, although at ten years' interval. Such cases are rare.

I have, however, now under observation a lady, æt. 66, who has had for at least ten years a perfect specimen of scirrhous carcinoma of her left breast which has remained unchanged for three years, whilst in her right she has had a rapidly-growing round-celled sarcomatous tumour removed with recurring growths on twelve occasions, during the three years, her general health being perfect.

Case 44. *Cystic carcinoma of breast.*—Mrs. R—, æt. 83, the mother of many children, all of whom she had suckled, consulted me on June 27th, 1877, for a cystic carcinoma of her left breast which had been coming on for one and a half years

The tumour was of the size of an orange and fluctuating. Skin over it infiltrated, but not the axillary glands. Nipple natural.

Maternal aunt had had cancer.

No operation advised on account of age.

Analysis of Cases.

The cases quoted, as seen in the table, include a good example of cystic degeneration of the breast in a married woman aged fifty-two; a second of cystic degeneration of the gland in a young married prolific woman aged thirty-four, the disease having attacked a gland which had never secreted milk although it had all the appearances of being healthy. In such a case degenerative glandular changes might be fairly looked for earlier than in glands which have been physiologically active.

Eight cases of simple non-proliferous cysts, three of which occurred in single women under forty years of age and five in married women, four of whom were sterile; cysts apparently being more frequently found in glands that have not been doing active duty than in others.

Four examples of simple sero-cystic disease are quoted, one in a single woman and three in married women, two being prolific. Only one of these patients had passed the age of forty.

Eighteen cases of cystic sarcoma with more or less adenoid structure. Six occurred in single and thirteen in married women, ten of whom had borne children. Two of these were under 40 years of age; 12 between 40 and 50, the remainder being 53, 63, 70, 71, and 71 respectively; the late period of life at which this disease attacks women being remarkable.

Twelve cases of cystic carcinoma.—All but one occurred in married women, and of these nine had been prolific. Six were in subjects between 41 and 50 years of age, and six in older women, aged respectively 56, 58, 60, 60, 70, and 83.

Taking the whole number of cases in which the cysts were proliferating as thirty; two only occurred in subjects under 40; seventeen in women between 41 and 50; five between the ages of 51 and 60; and six in subjects between 63 and 83.

Table of Treatment.

Three of the ten examples of simple cyst were punctured with good results; four were incised, plugged, and drained; one suppurated and was treated as an abscess; two were excised.

The lobule affected in one of the four examples of sero-cystic disease was excised and the whole gland removed in the other three cases.

Of the eighteen cystic sarcomatous cases, in four the diseased lobe alone was removed; in nine the whole gland was taken away, and in five no operation was performed.

Of the twelve examples of cystic carcinoma, in nine the diseased gland was removed, in three no operation was undertaken.

Of the forty-four examples of cystic disease of the breast three fourths were of a simple or sarcomatous nature and one fourth carcinomatous.

	Social condition.				Ages.				
		Married.		Number of cases.	Under 30.	Between 31 & 40.	Between 41 & 50.	Between 51 & 60.	Over 61.
	Single.	Prolific.	Sterile.						
Cystic	3	3	4	10	1	5	3	1	0
Sero-cystic	1	2	1	4	0	3	1	0	0
Cystic sarcoma	6	10	3	19	0	2	10	2	4 { 63, 71, 70, 71, respectively.
Cystic carcinoma	0	9	2	11	0	0	7	3	2—70, 83, respectively.
Cases	10	24	10	44	1	10	21	6	6 = 44.

PLATES I & II,

Illustrating Mr. Bryant's Paper on Cystic Tumours of the Breast.

PLATE I.

FIG. 1.—Microscopical appearance of breast undergoing cystic degeneration. From Case 1. A drawing of a section seen under Hart. oc. 3, obj. 4, tube out.

FIG. 2.—From Case 31. Of cystic adeno-sarcoma of the breast. It shows the cells lining the wall of the large cyst. Hart. oc. 3, obj. 7, tube out.

FIG. 3.—Case 31. From an outlying part of the breast, where it looked hard and grey. It shows spaces filled with cells, as well as others lined with them, and a fibrous matrix.

FIG. 4.—Case 31. A lobule showing cell proliferation, with destruction of the walls of the acini. A change going on widely through the breast.

FIG. 5.—Case 33. A representation under Hart. oc. 3, obj. 7, tube out, of the cells lining the spaces seen in the woodcut, fig. 2. A fibrous septum is shown with cells on either side, also the definite border where the cells limit the lumen. The few granules represent those composing the greenish-yellow thick material filling the spaces.

PLATE II.

FIG. 1.—Cystic-duct sarcoma. Case 30.

FIG. 2.—Cystic-duct adenoma. Case 18.

FIG. 3.—The pendulous intracystic adenoid growth from Case 17. The pedicle was small, and is represented here as being too wide.

FIG. 4.—A section of the same seen under Hart. oc. 3, obj. 7, tube in.

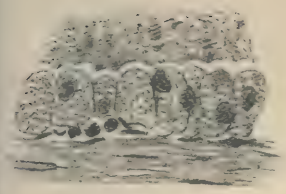


Fig. 2.

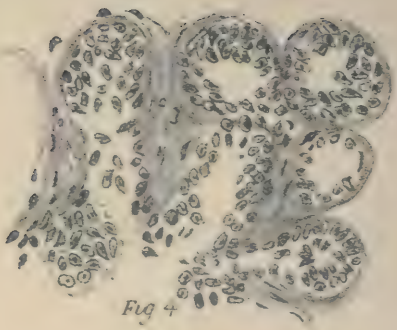


Fig. 4

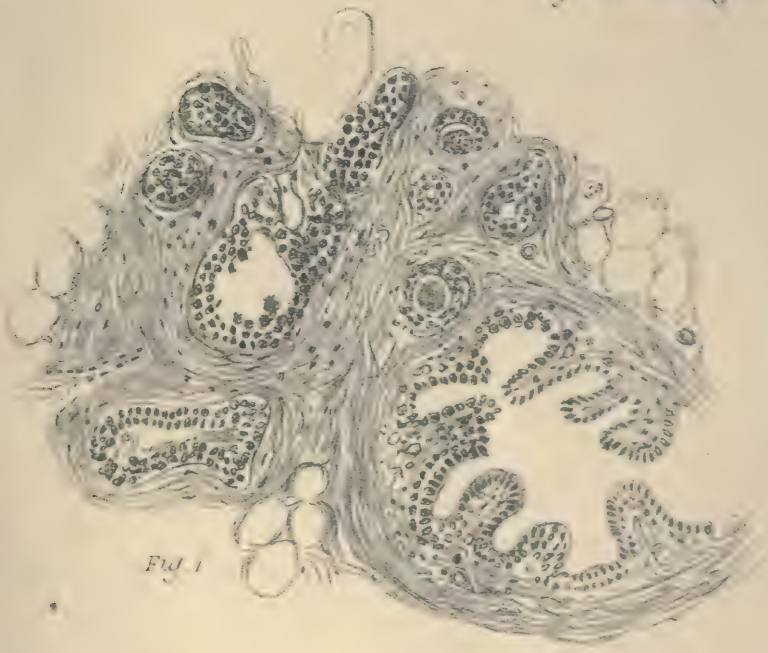


Fig. 1

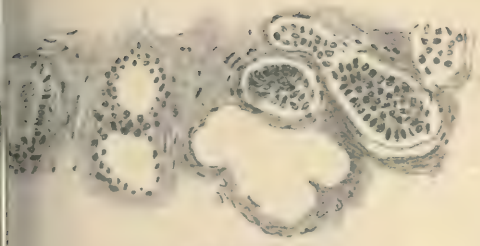


Fig. 3



Fig. 5

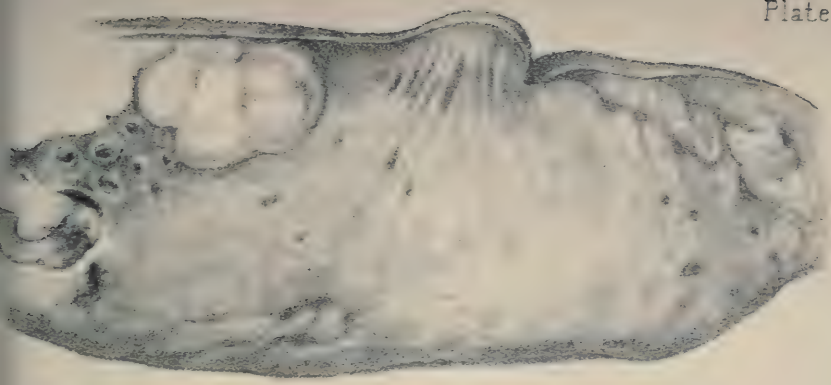


Fig. 1

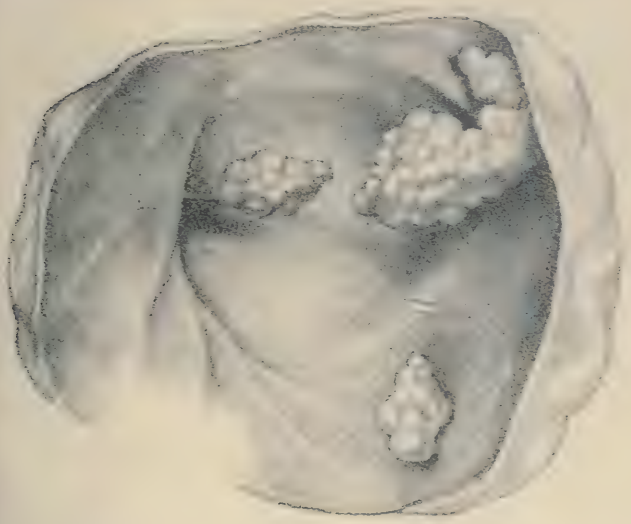


Fig. 2.

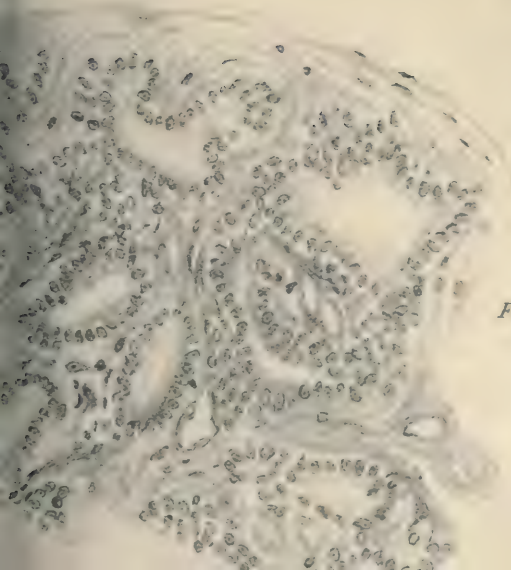


Fig. 4



Fig. 3

LIST

OF

GENTLEMEN EDUCATED AT GUY'S HOSPITAL

WHO HAVE PASSED THE

EXAMINATIONS OF THE SEVERAL UNIVERSITIES, COLLEGES, &c., &c.,

IN THE YEAR 1884.

University of Oxford.

First Examination for the Degree of Bachelor of Medicine.

F. S. Hawkins.

Final Examination for the Degree of Bachelor of Medicine.

R. J. Ryle.

University of Cambridge.

Examination for the Degree of Doctor of Medicine.

G. N. Pitt. | R. S. Taylor.

Final Examination for the Degree of Bachelor of Medicine.

J. H. H. Manley. | R. L. Knaggs.
D. C. Trott. | G. Turner.

Second Examination for the Degree of Bachelor of Medicine.

E. S. Blaker. | A. S. Taylor.
E. P. Manby. | A. H. Williams.
E. H. Lipscomb.

First Examination for the Degree of Bachelor of Medicine.

E. H. Lipscomb. | E. P. Manby.
A. Reeves. | E. S. Blaker.

University of London.

Examination for the Degree of Doctor of Medicine.

J. H. Champ.

Obtained marks Qualifying for Gold Medal.

W. Hind.

Logic and Psychology only.

S. Worthington.

Final Examination for the Degree of Bachelor of Medicine.

First Division.

G. E. C. Anderson.

Obtained Honours in Obstetric Medicine and in Forensic Medicine.

W. H. Bowes. | C. Gross.

Second Division.

W. W. Floyer.

Intermediate Examination in Medicine.

First Division.

S. R. Alexander.

Obtained Honours in Anatomy, Physiology and Histology.

F. F. Burghard.

Obtained First-Class Honours in Materia Medica, and in Organic Chemistry, and Honours in Physiology and Histology.

W. F. Clarke.

Obtained Honours in Anatomy.

G. Rowell.

Obtained Honours in Organic Chemistry.

Second Division.

J. E. Nevins.

Obtained Honours in Materia Medica.

H. Smith.

Obtained Honours in Materia Medica.

R. A. Bindley. | W. H. W. Elliot.
H. J. Blackler. | J. A. Wheeler.

Excluding Physiology.

A. Green. | W. N. Risdon.

Preliminary Scientific (M.B.) Examination.

First Division.

J. D. Cruickshank.

Second Division.

C. J. Martin.

Obtained Honours in Inorganic Chemistry and Experimental Physics.

C. Price-Jones.

Obtained the Exhibition and First-Class Honours in Zoology.

W. J. Maillard.

Obtained Honours in Botany.

G. L. Kemp.

Obtained Honours in Inorganic Chemistry.

C. S. Davis.
A. D. Fripp.
H. V. Hickman.
A. B. Hudson.
R. D. Mothersole.
A. E. Norburn.
C. F. Routh.

Passed in Botany only.

D. T. Jones.
C. Legg.
D. F. Roberts.

Passed in Zoology only.

T. Wilson-Smith.

Final Examination for the Degree of Bachelor of Surgery.

First Division.

W. H. Bowes.
C. Gross.

Second Division.

G. E. C. Anderson.
W. T. F. Davies.
M. Parry-Jones.

Intermediate Examination in Science.

First Division.

A. D. Sanderson.

Examination for the Degree of Bachelor of Science.

Second Division.

J. L. Roberts.

University of Durham.

Final Examination for the Degree of Bachelor of Medicine.

J. V. Salvage.

First Examination for the Degree of Bachelor of Medicine.

P. T. Adams.
H. Gilford.
J. W. Sandoe.
W. A. Slater.

Examination for the Degree of Master of Surgery.

J. V. Salvage.

University of Edinburgh.

Examination for the Degree of Doctor of Medicine.

G. F. Crooke.

Second Examination for the Degree of Bachelor of Medicine.

F. H. Knaggs. | E. W. Skinner.
W. C. Spiller.

First Examination for the Degree of Bachelor of Medicine.

E. W. Skinner.

Royal University of Ireland.

Final Examination for the Degree of Bachelor of Medicine.

E. A. Starling.

Final Examination for the Degree of Master of Surgery.

E. A. Starling.

Final Examination for the Diploma in Obstetrics.

E. A. Starling.

British Medical Service.

Netley Examination in February.

T. B. Winter, 2105 marks.

Naval Medical Service.

February—J. Dowson, 2070 marks.
August—E. R. D. Fasken, 1840 marks.

Royal College of Physicians.

Examination for the Membership.

G. N. Pitt, M.D. Cantab. | A. G. Barrs, M.D. Edin.

Final Examination for the Licence.

January.

E. H. Armitage.
C. E. Beebe.
G. H. Graham.
J. W. Harris.
F. E. Hubbard.
A. G. Mimns.
M. A. Muirhead.
E. Sharpley.
W. Spong.
D. C. Trott.
E. T. Trevor.
J. J. Udale.
L. Burroughs.

April.

C. E. Bean.
M. Carnelley.
A. W. Clark.
A. C. Deare.
S. A. Davies.
A. H. Dodd.
A. S. Topham.
R. A. Milligan.
G. Kendall.
J. G. Milnes.
R. W. Murray.
St. J. O. Rands.
A. L. Tireman.
H. H. Wright.

July.

R. W. Brogden.
H. A. Fotherby.
A. H. Fowler.
E. C. Greene.
J. Harvey.
F. R. Humphreys.
E. G. Hunt.
J. V. Salvage.
G. R. M. Pollard.

October.

R. A. Baillie.
W. L. Blight.
C. T. Griffiths.
R. J. Kerby.

Royal College of Surgeons.

Final Examination for the Fellowship.

L. A. Dunn, M.B.
W. Fowler, M.B. Cantab.
R. L. Knaggs.
R. H. Perks.
J. W. Sanders.
T. H. Morse.
W. C. Dendy.

First Examination for the Fellowship.

H. Lund.
S. Wacher.
C. Metzgar.
G. Rowell.
J. W. Washbourn.
H. Gilford.
S. W. Owen.

Final Examination for the Membership.

January.

J. W. Harris.
E. D. Minter.
J. J. Prendergast.
A. H. Jackson.
A. S. Kendall.
J. J. Parsons.
R. Koettlitz.
J. F. Saunders.
E. J. Wenyon.
A. J. Carter.
G. H. H. Fuller.
J. Harvey.
D. G. Edwards.
M. Carnelley.
W. Growse.
R. P. Samut.
C. E. Bean.
E. H. Armitage.
A. H. Dodd.
A. G. Minns.

April.

S. A. Davies.
G. E. C. Anderson.
W. L. Braddon.
G. F. Hugill.
A. De Winton.
W. H. Bowes.
E. L. Brockliss.
H. Lamb.
F. R. Humphreys.
S. H. Agar.
R. W. Murray.
H. C. E. Cooper.
A. C. Deare.

July.

T. H. Miller.
W. A. Aikin.
R. W. Brogden.
A. H. Fowler.
A. E. Taylor.
A. H. Tubby.
J. J. D. Vernon.
C. D. Muspratt.
F. Pearse.
R. M. H. Randell.
R. A. Baillie.
W. L. Blight.
A. L. Scott.
L. J. Kidd.
W. L. W. Marshall.
E. W. Phillips.
C. S. Spong.
J. H. Greenway.
W. J. C. Tomalin.

October.

C. Caldecott.
E. S. Marder.
R. G. Silverlock.
H. E. Counsell.
E. C. Greene.
W. L. Rhys.
G. E. Stewart.
H. J. Hillstead.
R. J. Kerby.
F. W. H. Penfold.
G. W. Mullis.

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Honorary Secretaries.—R. E. CARRINGTON, M.D.; W. HALE WHITE, M.D.

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To Mr. A. H. Tubby, £10, for his Paper on "Diagnosis and Treatment of Hip-Joint Disease."

To Mr. R. M. Randell, £5, for his Paper on "The Uses of Iodoform."

To Mr. R. J. Kerby, £2 10s., for his Paper on "Differential Diagnosis of Coma and Convulsions."

To Mr. G. Rowell, £2 10s., for his Paper on "The Physiological Relation of Urea."

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H. G. Dixon.
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W. Gay.
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H. Vallance.
T. Slater-Jones.
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E. W. Goodall.
E. Goodall.
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W. H. Boger.
A. W. Webb.
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W. P. West.
F. Lever.
E. S. Blaker.
S. Wacher.
E. W. Du Buisson.
H. J. Roberts.
H. Lund.
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E. W. Phillips.
C. G. Wallis.
W. F. Tronson.
W. H. Boger.
J. H. Blight.
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C. J. Cressy.
H. A. Reed.
J. G. Harsant.
B. C. Gowan.
J. S. Grose.
E. C. Kingsford.
E. C. Hare.
C. G. Wallis.
A. E. Wilson.
J. W. Washbourn.
H. K. Roper.
S. W. Owen.
P. N. Randall.
C. Metzgar.
E. W. Du Buisson.
G. Rowell.
W. H. W. Elliott.
E. Lester.
E. Halstead.
E. W. Marshall.
P. Purnell.
F. W. Turtle.
E. A. Farr.

J. N. Phillips.
F. Lever.
S. H. Seccombe.
A. E. Price.
H. J. Blackler.
C. Pollard.
R. Capes.
L. Bidwell.
F. Beard.
J. E. Nevins.
F. Wyatt Smith.
G. Niven.
J. H. Cuolahan.
M. Yunge Bateman.
C. N. Graham.
A. A. Smith.
F. W. Farr.
N. J. N. Bray.
F. R. H. Potts.
G. T. Rawnsley.
E. B. Harris.
J. A. Benson.
P. Rose.
F. K. Holman.

H. Stelfox.
W. Bett.
M. E. A. Wallis.
W. B. Colquhoun.
A. E. Palmer.
T. F. Bridwood.
C. A. McAnally.
T. John.
W. Lansdale.
J. A. Ward.
E. N. Hearnden.
D. A. Waite.
S. F. Holloway.
T. Halliwell.
J. A. Wheeler.
F. R. Farmer.
A. H. Johnston.
A. Scott.
H. E. Crook.
A. S. Taylor.
A. T. Brown.
E. P. Manby.
F. S. Hawkins.
F. Pearce.

AURAL SURGEON'S DRESSERS.

E. P. Mourilyan.
S. A. Mugford.
C. P. Walker.

W. Growse.
W. T. Hodge.
M. W. Oldham.

H. E. Jones.
A. H. Tubby.
H. J. Roberts.

ASSISTANT PHYSICIANS' CLERKS.

W. J. Lee.
E. K. Alderson.
J. D. Howe.
C. E. Bean.
C. P. Walker.
R. J. Ryle.
L. F. Childe.
J. H. Sellick.
A. S. Topham.
E. P. Mourilyan.
F. R. Humphreys.
E. W. Phillips.
A. H. Dodd.
J. A. Fox.
A. M. Sutton.
S. R. Alexander.
M. W. Oldham.
P. M. Earle.
F. Heatherley.
E. S. Marder.
A. H. Fowler.
E. C. Kingsford.
H. Lamb.
S. H. Agar.
F. E. Cave.
H. E. Jones.
R. G. Silverlock.
T. Slater-Jones.
H. E. Crook.
G. B. Harrop.
G. F. Pollard.
J. R. I. Raywood.
W. F. Tronson.
F. W. Foster.
W. M. Sheen.
L. Bidwell.

POST-MORTEM CLERKS.

A. A. Jeyes.
S. Wacher.
E. Deane.
R. J. Kerby.
W. T. Hodge.
H. J. Hillstead.
F. Pearce.
G. F. Hugill.
J. W. Washbourn.
W. H. Bowes.
R. Moody-Ward.
S. H. Agar.
H. St. G. S. Hore.
G. T. Rawnsley.
M. Dundas.
M. E. A. Wallis.
E. B. Harris.
W. Bett.
C. W. Hogarth.
E. W. Goodall.
R. W. Murray.

OBSTETRIC OUT-PATIENTS CLERKS.

E. R. B. Archer.
G. H. Hugill.
E. H. Armitage.
H. E. Jones.
W. H. Dodd.
J. V. Salvage.
A. M. Sutton.
F. R. B. Bisshopp.
E. S. Marder.
A. H. Tubby.
M. Yunge-Bateman.
A. H. Fowler.
F. W. Foster.
G. F. Pollard.
M. G. Dundas.
E. A. Farr.
W. L. Rhys.
F. W. Farr.
C. Pollard.
A. E. Taylor.
S. E. Prall.
E. W. Marshall.
E. Goodall.
G. T. Rawnsley.

OBSTETRIC WARD CLERKS.

E. C. Greenwood.
W. L. Blight.
J. D. Hughes.
H. E. Jones.
W. P. Le Feuvre.
P. M. Earle.
D. T. Lewis.
R. Creasy.
S. H. Seccombe.
F. H. Knaggs.
R. A. Bindley.
F. W. Wakefield.

EXTERN OBSTETRIC ATTENDANTS.

F. Beard.
T. R. Rolston.
R. Creasy.
A. G. Mossop.
P. O. W. Hailey.
E. H. Lipscomb.
R. G. Silverlock.
A. W. Webb.
F. R. H. Potts.
C. N. Graham.
H. H. Du Boulay.
J. H. Sellick.
L. F. Childe.
P. C. C. Billups.
R. M. H. Randell.
H. J. Campbell.
A. M. Sutton.
W. L. Rhys.
A. H. Tubby.
W. L. Braddon.
W. B. Colquhoun.
H. E. Crook.
F. Wyatt Smith.
G. Niven.
T. Slater-Jones.
J. H. Blight.
C. J. Cressy.
A. Meyrick-Jones.
R. Capes.
T. John.
F. W. Turtle.
C. Pollard.
E. C. Andrews.

EXTERN OBSTETRIC ATTENDANTS (*continued*).

W. P. Smart.
C. H. West.
S. H. Seccombe.
P. Rose.
W. P. Warburton.
W. P. Smart.
E. B. Harris.
E. H. Greaves.
E. W. Goodall.

E. Goodall.
J. G. Harsant.
E. W. Marshall.
P. Rose.
L. Bidwell.
W. F. Clarke.
F. W. Langridge.
T. Fisher.
J. A. Ward.

C. A. McAnally.
R. Denman.
A. Crossley.
J. N. Phillips.
J. W. Sandoe.
E. C. Hare.
H. Lund.
R. A. Bindley.
W. Ashby.

SURGICAL WARD CLERKS.

A. Carver.
G. E. Halstead.
M. Yunge-Bateman.
E. W. Marshall.
P. Purnell.
W. P. West.
D. A. Waite.
A. E. Price.
H. Gilford.
R. Capes.
H. J. Roberts.
S. H. Seccombe.
E. A. Farr.
J. N. Phillips.
L. Bidwell.
E. S. Blaker.
F. Lever.
C. Pollard.
G. Niven.
F. Wyatt-Smith.
C. N. Graham.
A. Cuolahan.
N. J. N. Bray.
T. John.
G. F. E. Morgan.
A. Meyrick-Jones.
G. T. Rawnsley.

P. Rose.
H. Stelfon.
E. Deane.
A. E. Wilson.
F. R. H. Potts
S. Wacher.
W. W. Williams.
W. A. Cahill.
J. A. Benson.
D. M. Evans.
F. W. Farr.
E. B. Harris.
A. A. Smith.
F. K. Holman.
W. B. Colquhoun.
J. W. Washbourn.
T. F. Christal.
J. F. Bridgwood.
C. Metzgar.
J. A. Ward.
E. M. Hearnden.
A. H. Johnston.
E. Moss.
C. W. Hogarth.
F. R. Farmer.
H. W. Drew.
H. E. Crook.

F. S. Hawkins.
A. S. Taylor.
A. Crossley.
A. Z. C. Cressy.
W. P. Smart.
G. H. Metcalfe.
F. Pearce.
C. H. West.
W. P. Le Feuvre.
W. N. Risdon.
E. H. Brock.
S. de B. Mesquita.
C. S. Simpson.
G. A. Wybourn.
T. G. Scott.
J. F. Rymer.
P. Paget.
F. T. Frost.
C. S. Shute.
H. V. Rake.
E. F. Gardner.
F. F. Burghard.
C. F. Routh.
C. A. Lumley.
A. E. Palmer.
J. E. Nevins.
S. Woodhams.

ASSISTANT SURGEONS' CLERKS.

C. G. Thorp.
T. L. Aymard.
J. E. Nevins.
F. Beard.
J. L. Roberts.
G. H. Pennell.
C. S. Sturges-Jones.
J. A. Roker.
W. E. Tresidder.
G. T. Cattell.
P. T. Adams.

C. D. H. Rygate.
A. E. Poolman.
R. S. Freeland.
R. G. Pollock.
C. Pollard.
J. M. Thorne.
J. C. Baines.
T. S. Coombe.
W. Fisher.
W. P. Warburton.
J. T. Brickwell.

A. D. Meares.
J. A. Benson.
W. J. Scott.
G. Black.
M. Dundas.
W. Ashby.
P. Rose.
J. Hutchinson.
E. W. Marshall.
A. H. Atkin.

LIST

OF

GENTLEMEN EDUCATED AT GUY'S HOSPITAL,

WHO HAVE PASSED THE

EXAMINATIONS OF THE SEVERAL UNIVERSITIES, COLLEGES, &c., &c.,

IN THE YEAR 1885.

University of Oxford.

First Examination for the Degree of Bachelor of Medicine.

G. H. Pennell.

University of Cambridge.

Final Examination for the Degree of Bachelor of Medicine.

G. Niven. | F. Beard.
E. C. Andrews. | H. Lund.

Second Examination for the Degree of Bachelor of Medicine.

A. T. MacConkey. | C. J. Whitby.
E. H. Lipscomb.

First Examination for the Degree of Bachelor of Medicine.

E. J. D. Mitchell.

Final Examination for the Degree of Bachelor of Surgery.

E. C. Andrews. | H. Lund.

University of London.

Examination for the Degree of Doctor of Medicine.

G. E. C. Anderson. | A. Martin.
W. H. Bowes. | C. H. L. Meyer.
M. Parry-Jones.

Logic and Psychology only.

F. H. Berry. | E. H. Booth.
G. R. Marsh.

Final Examination for the Degree of Bachelor of Medicine.

First Division.

E. W. Goodall.
Obtained the Exhibition and Gold Medal in Forensic Medicine.

R. M. H. Randell.
Obtained Honours in Forensic Medicine.

J. I. Boswell. | J. H. Sellick.
L. F. Childe. | A. M. Sutton.
A. E. Price. | J. J. D. Vernon.

Second Division.

F. Lever.
Obtained Honours in Forensic Medicine.

R. W. Brogden. | J. G. Harsant.
E. P. Mourilyan.

Intermediate Examination in Medicine.

First Division.

G. Black.
Obtained Honours in Physiology and Histology.

T. Fisher.
Obtained First-Class Honours in Materia Medica.

J. L. Roberts.
Obtained First-Class Honours in Physiology, and Honours in Organic Chemistry.

A. Scott.
Obtained Honours in Organic Chemistry.

G. B. Smith.
Obtained Honours in Anatomy.

E. H. Starling.
Obtained the Exhibition and Gold Medal in Organic Chemistry, the Exhibition and Gold Medal in Physiology and Histology, and Marks qualifying for the Gold Medal in Materia Medica.

A. H. Tubby.
Obtained Honours in Anatomy and Materia Medica.

E. H. Brock.
H. E. Crook.
H. E. Cuff.
W. J. Maillard.
H. K. Roper.
R. A. Sawyer.
W. A. Slater.

Second Division.

S. B. de Mesquita.
E. Moss.
P. N. Randall.
C. F. Routh.
F. P. Sarjant.
H. E. Vincent.
M. G. Yunge-Bateman.

Excluding Physiology.

First Division.

W. E. Tresidder.

Second Division.

A. T. Brown.

Physiology only.

W. N. Risdon.

Preliminary Scientific (M.B.) Examination.

First Division.

C. McG. Kitching.
J. S. Richards.
J. Robertson.
R. E. Williams.

Second Division.

E. M. Dobinson.
A. E. Tebb.
C. J. Girling.

Honours Candidates recommended for a Pass.

J. M. Gill.
T. F. Ricketts.

Zoology only.

H. A. Edmonds.

Obtained Honours in Botany.

F. W. Hall.
S. G. Toller.

Final Examination for the Degree of Bachelor of Surgery.

First Division.

A. E. Price.

Obtained First-Class Honours and Marks qualifying for Gold Medal

J. H. Targett.

Obtained Second-Class Honours.

Second Division.

R. W. Brogden.
J. G. Harsant.
F. Lever.

University of Durham.

Final Examination for the Degree of Bachelor of Medicine.

H. J. Hillstead. | C. P. Walker.

First Examination for the Degree of Bachelor of Medicine.

R. Thompson.

Examination for the Degree of Master of Surgery.

C. P. Walker.

Sanitary Science Examination.

C. P. Walker.

University of Edinburgh.

Final Examination for the Degree of Bachelor of Medicine.

W. C. Spiller. | E. W. Skinner.

First Examination for the Degree of Bachelor of Medicine.

W. Wilson.

British Medical Service.

August.

W. J. Lee, 2500 marks.
J. W. F. Long, 2215 „
J. H. Greenway, 1921 „

Royal College of Physicians.

Examination for the Membership.

W. R. Dakin, M.D. Lond. | L. E. Shaw, M.D. Lond.
L. C. Wooldridge, M.B. Lond.

Final Examination for the Licence.

G. H. De'Ath.
G. W. Mullis.
G. E. Stewart.
J. H. Blight.
R. Creasy.
W. Growse.
G. F. Hugill.
H. Lamb.
W. J. Lee.
E. R. S. Lipscomb.
W. L. Rhys.
G. R. M. Pollard.
J. C. Underwood.
W. H. Dodd.
E. W. Du Buisson.
H. St. G. S. Hore.
T. B. Jacobson.
G. Schofield.
P. O. W. Hailey.
J. D. Hughes.
M. Koellitz.
J. P. Martin.
E. W. Phillips.
H. A. Reed.
A. W. Webb.

Royal College of Surgeons.

Final Examination for the Fellowship.

F. N. Pedley.
S. Worthington.
H. W. Pigeon.
C. D. Muspratt.
W. L. Braddon.

First Examination for the Fellowship.

A. H. Tubby.
A. S. Taylor.
R. T. Kent.
F. S. Hawkins.
H. E. Crook.
H. Smith.
H. W. Drew.
H. K. Roper.
J. L. Roberts

Final Examination for the Membership.

January.

H. C. Ensor.
E. Goodall.
R. Moody-Ward.
G. Wornum.
G. T. Cattell.
M. Dundas.
H. E. Jones.
F. Heatherley.
J. H. Sellick.

April.

J. H. Blight.
R. Creasy.
R. Hehir.
W. J. Lee.
A. Sutton.
W. F. Tronson.
F. Lever.
E. Apthorp.
F. Beard.
A. E. Price.
A. Green.
P. O. W. Hailey.
F. H. Knaggs.
J. D. Howe.

July.

G. Schofield.
E. W. Du Buisson.
H. St. G. S. Hore.
T. Slater-Jones.
H. Lund.
F. R. B. Bisshopp.
S. E. Prall.
F. W. Foster.
S. W. Owen.
J. W. Washbourn.
E. C. Andrews.
L. F. Childe.
E. P. Mourilyan.
A. M. Sutton.
H. A. Reed.
J. D. Hughes.
G. R. M. Pollard.
J. R. I. Raywood.

October.

F. W. Farr.
H. Vallance.
J. H. Collymore.
E. A. Farr.
A. W. Webb.
H. H. Du Boulay.

Society of Apothecaries.

Surgical Scholarship of £100, *tenable for two years.*

William Henry Bowes, M.D.

MEDALLISTS AND PRIZEMEN, 1884-85.

The Treasurer's Gold Medal for Clinical Medicine.

William Leonard Braddon, Upton-on-Severn.

The Treasurer's Gold Medal for Clinical Surgery.

John Wychenford Washbourn, Gloucester.

Gurney Hoare Prize for Clinical Study.

Letterstedt Frederick Childe, Tunbridge Wells.

Beaney Prize for Pathology.

George Elliot Caldwell Anderson, Oudstboorn, Cape Colony.
William Henry Bowes, Herne Bay (*Proxime Accesserunt*).

Mackenzie Bacon Prize for Ophthalmoscopy.

Charles Drummond Muspratt, Clapham.

Mackenzie Bacon Prize for Nervous Diseases.

George Ezra Halstead, Balderton, Newark.

Michael Harris Prize for Anatomy.

Arthur Edward Poolman, Sydney, New South Wales.

The Burdett Prize for Hygiene.

William Leonard Braddon, Upton-on-Severn.

Fourth Year's Students.

John Wychenford Washbourn, Gloucester, First Prize, £25.
Frederick Lever, Epsom, Second Prize, £10.
Sidney Wacher, Eddington, Canterbury, Certificate.
Edward Deane, Reading, Certificate.

Third Year's Students.

Frédéric François Burghard, Kensington, First Prize, £25.
Herbert Vaughan Rake, Fordingbridge, Second Prize, £10.
William Bett, Holbeach, Lincoln, Certificate.
Edward Petronell Manby, East Rudham, Certificate.

Second Year's Students (*Joseph Hoare Prizes*).

Ernest Henry Starling, Bombay, First Prize, £25.
Guy Bellingham Smith, Lee, Second Prize, £10.
George Herbert Pennell, Heavitree, Exeter, Certificate.

First Year's Students.

Robert Devereux Mothersole, Colchester, } equal { £37 10*s.*
Alfred Parkin, Hightown, Yorks. } { £37 10*s.*
Ramsay Allan Bremner, South Norwood, Certificate.
Cecil Price-Jones, Surbiton, Certificate.

Physical Society.

Session 1885-86.

Honorary President.—SAMUEL WILKS, M.D., F.R.S.

Presidents.

Messrs. G. E. C. Anderson, M.D., B.S., F. Beard, W. L. Braddon, W. H. Bowes, M.D., B.S., H. E. Crook, E. W. Goodall, E. C. Kingsford, A. Martin, M.D., R. Moody-Ward, B.A., M.B., M. Parry-Jones, M.B., J. I. Parsons, M.B., F. B. W. Phillips, M.A., M.B., B.Sc., R. M. H. Randell, J. H. Sellick, C. S. Spong, B.Sc., W. A. Slater, B.Sc., A. H. Tubby, S. Wacher, J. W. Washbourn.

Honorary Secretaries.

R. E. CARRINGTON, M.D., W. HALE WHITE, M.D.

PRIZEMEN FOR THE SESSION, 1884-85.

To Mr. H. E. Crook, £10, for his Paper on "Anthrax Bacillus."

The Second Prize of £5 was equally divided between Mr. F. Beard for his Paper on "Otorrhœa," and Mr. S. Wacher for his Paper on "The Clinical Examination of the Urine."

To Mr. E. W. Goodall, £5, as the Member who distinguished himself most in the Debates of the Session.

To Mr. F. F. Burghard, the Essay Prize, for his Essay on "The Mechanism of Human Joints."

CLINICAL APPOINTMENTS HELD IN THE YEAR 1885.

RESIDENT HOUSE PHYSICIANS.

R. L. Knaggs, M.B.	G. E. C. Anderson, M.D.
R. W. Brogden, M.B.	A. Martin, M.D.
W. A. Aikin.	F. B. W. Phillips, M.B.

RESIDENT HOUSE SURGEONS.

M. Parry-Jones, M.D.	J. H. Targett, M.B.
J. V. Salvage, M.B.	C. D. Muspratt.
J. I. Parsons.	S. Worthington. M.B.

RESIDENT OBSTETRIC ASSISTANTS.

W. Fowler, M.B.	R. W. Brogden, M.B.	G. E. C. Anderson, M.D.
E. Roberts.	C. S. Spong.	W. L. Braddon.
W. W. Floyer, M.B.	A. E. Taylor.	F. Heatherley.
R. L. Knaggs, M.B.	W. H. Bowes, M.D.	H. E. Counsell.
G. H. Rodman, M.B.		

SURGEONS' DRESSERS.

F. R. B. Bisshopp.	R. A. Bindley.	A. E. Price.
H. H. Du Boulay.	H. E. Counsell.	H. Lund.
F. Heatherley.	F. H. Knaggs.	A. W. Webb.
J. G. Harsant.	E. Goodall.	S. R. Alexander.
J. H. Sellick.	F. Lever.	H. J. Roberts.
G. G. O. Phillips.	S. Wacher.	F. Beard.
A. Green.	S. E. Prall.	G. E. Halstead.
E. W. Goodall.	E. P. Mourilyan.	R. Creasy.

CLINICAL ASSISTANTS.

A. M. Sutton.
H. J. Hillstead.
W. I. Watson.
C. D. Muspratt.
T. Slater-Jones.
R. Moody-Ward.
H. E. Jones.
L. F. Childe.
J. G. Harsant.
J. H. Blight.
R. M. H. Randell.
E. W. Du Buisson.
R. A. Bindley.
A. H. Tubby.
J. W. Washbourn.
H. Lund.
G. Niven.
S. Wacher.

DRESSERS IN THE EYE WARDS.

G. E. C. Anderson.
R. M. H. Randell.
F. E. Cave.
M. W. Oldham.
C. S. Spong.
W. L. Braddon.
A. E. Larking.
W. H. Bowes.
A. E. Taylor.
W. J. Lee.
A. M. Sutton.
F. R. B. Bisshopp.
F. W. Foster.
A. E. Wilson.
W. I. Watson.
T. Slater-Jones.
S. W. Owen.
E. Deane.
F. Heatherley.
F. W. Farr.
W. W. Floyer.
J. G. Harsant.
H. St. G. S. Hore.
J. Crisp.

DENTAL SURGEONS' DRESSERS.

F. S. Hawkins.
J. R. I. Raywood.
C. W. Hogarth.
W. B. Shelswell.
A. E. Taylor.
M. W. Oldham.
C. J. Cressy.
F. W. Foster.
H. Gilford.
W. Lansdale
R. Capes.
W. S. Brown.

MEDICAL WARD CLERKS.

C. J. Cressy.
E. Lester.
B. C. Gowan.
J. D. Hughes.
C. G. Wallis.
S. R. Alexander.
E. C. Kingsford.
W. S. Brown.
J. S. Grose.
G. Schofield.
S. W. Owen.
H. Gilford.
R. Creasy.
A. E. Price.
G. Niven.
F. R. Bolton.
P. N. Randall.
E. Deane.
J. Crisp.
A. Cuolahan.
G. E. Halstead.
W. B. Colquhoun.
M. Yunge-Bateman.
N. J. N. Bray.
P. Purnell.
E. W. Marshall.
A. A. Smith.
F. W. Farr.
E. A. Farr.
J. W. Washbourn.
C. Metzgar.
W. H. W. Elliott.
G. Rowell.
H. J. Blackler.
F. Wyatt Smith.
C. A. McAnally.
T. John.
W. Lansdale.
J. W. Sandoe.
W. P. Le Feuvre.
R. Capes.
L. Bidwell.
C. Pollard.
F. Pearce.
J. N. Phillips.
S. H. Seccombe.
F. R. H. Potts.
E. H. Lipscomb.
E. P. Manby.
E. C. Andrews.
J. E. Nevins.
E. M. Hearnden.
W. Bett.
W. J. Rawnsley.
H. Stelfox.
D. A. Waite.
T. F. Christal.
A. Meyrick-Jones.
P. Rose.
J. A. Ward.
C. S. Simpson.
J. T. Bridgwood.
E. B. Harris.
A. Crossley.
J. F. Rymer.
H. W. Drew.
H. V. Rake.
A. S. Taylor.
F. F. Burghard.
P. Purnell.
R. Denman.
H. T. Jones.

ASSISTANT SURGEONS' DRESSERS.

F. Lever.
J. E. Nevins.
J. S. Sandoe.
C. A. McAnally.
E. H. Lipscomb.
S. Wacher.
L. Bidwell.
E. M. Hearnden.
S. H. Seccombe.
F. Pearce.
G. T. Rawnsley.
E. S. Blaker.
H. K. Roper.
D. A. Waite.
C. Pollard.
A. E. Wilson.
J. N. Phillips.
R. Capes.
W. Lansdale.
T. John.
A. Crossley.
F. H. Holman.
G. A. Wybourn.
H. Stelfox.
A. Cuolahan.
E. C. Hare.
T. F. Christal.
A. Meyrick-Jones.
J. F. Bridgwood.
A. H. Johnston.
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WINTER COURSES.

The Winter Session commences October 1st and ends March 31st

LECTURES.

Medicine.—Dr. MOXON and Dr. PYE-SMITH.
Mondays, Wednesdays, and *Fridays,* at Three.

Clinical Medicine.—Dr. PAVY, Dr. MOXON, Dr. PYE-SMITH, and Dr. TAYLOR.
Saturdays, at Half-past One.

Surgery.—Mr. BRYANT and Mr. DURHAM.
Tuesdays and *Thursdays,* at Half-past Three, and *Saturdays,* at a Quarter to Three.

Clinical Surgery.—Mr. BRYANT, Mr. DURHAM, Mr. HOWSE, and Mr. DAVIES-COLLEY.
Wednesdays, at Half-past One.

Ophthalmic Surgery.—Mr. HIGGENS.
Wednesdays, at Three.

Anatomy, Descriptive and Surgical.—Mr. HOWSE and Mr. DAVIES-COLLEY.
Tuesdays, Wednesdays, Thursdays, and *Fridays,* at Nine.

Physiology and General Anatomy.—Mr. GOLDING-BIRD.
Mondays, Wednesdays, and *Fridays,* at a Quarter-past Four.

Clinical Lectures on Midwifery and Diseases of Women.—Dr. GALABIN.
Wednesdays, at Half-past One.

Chemistry.—Dr. DEBUS, F.R.S., and Dr. STEVENSON.
Tuesdays, Thursdays, and *Saturdays,* at Eleven.

Experimental Physics.—Prof. A. W. REINOLD, F.R.S.
Mondays and *Wednesdays,* at Eleven.

Biology.—Mr. F. E. BEDDARD, M.A.

DEMONSTRATIONS.

Practical Surgery.—Mr. LUCAS.

Surgical Classes.—Mr. JACOBSON, *Daily.*

Practical Obstetrics.—Dr. HORROCKS.

Practical Anatomy.—Mr. W. A. LANE, Mr. J. POLAND, and Mr. L. A. DUNN, *Demonstrators.*
And two Assistant Demonstrators.

Morbid Anatomy.—Dr. GOODHART and Dr. CARRINGTON.
Daily, at Half-past Two.

Cutaneous Diseases.—Dr. PYE-SMITH and Dr. CARRINGTON.
Tuesdays, at Twelve.

Practical Physiology.—Dr. WOOLDRIDGE.
Tuesdays and *Thursdays,* at Ten.

Morbid Histology.—Mr. SYMONDS.
Two days in the week.

Practical Pharmacy.

SUMMER COURSES.

The Summer Session begins May 1st and ends July 31st.

LECTURES.

Materia Medica and Therapeutics.—Dr. TAYLOR.
Mondays, Tuesdays, and *Thursdays,* at Two.

Midwifery and Diseases of Women.—Dr. GALABIN.
Tuesdays, Wednesdays, Thursdays, and *Fridays,* at Nine.

Medical Jurisprudence.—Dr. STEVENSON.
Tuesdays, Thursdays, and *Saturdays,* at Ten.

Clinical Medicine.—Dr. GOODHART, Dr. CARRINGTON, and Dr. WHITE.
Wednesdays, at Half-past One.

Clinical Surgery.—Mr. LUCAS, Mr. GOLDING-BIRD, Mr. JACOBSON, and Mr. SYMONDS.
Fridays, at Half-past One.

Clinical Lectures on Diseases of Women.—Dr. HORROCKS.
Tuesdays, at Half-past One.

Pathology.—Dr. GOODHART, *Saturdays,* at Nine.

Hygiene.—Mr. GEORGE TURNER, *Mondays* and *Fridays,* at Half-past Eleven.

Mental Diseases.—Dr. SAVAGE.
Tuesdays, at Eleven, and *Fridays,* at Half-past Ten.

Biology.—Mr. F. E. BEDDARD, M.A.

Dental Surgery.—Mr. MOON.

DEMONSTRATIONS.

Practical Chemistry.—Mr. C. E. GROVES, F.R.S.
Mondays, Wednesdays, and *Fridays,* Ten to One.

Operative Surgery.—Mr. LUCAS.
Mondays, Wednesdays, and *Fridays,* at Four.

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